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EDITORIAL.

For several years there has been much inquiry for a brief article epitomizing the chief practical results of Child Study with references to the most important original articles, but the editor has felt that the time had not yet come for such a summary. When, however, near the close of a three years' residence as Student and Fellow at Clark University, Mr. Ellis had nearly completed a History of the Philosophy of Education from Plato down, it was felt that such a work would not be complete without a final chapter surveying the Child Study movement, which, under a simple and unattractive name, is slowly doing a work for studies of mind not all unlike that which Darwin did for the methods of nature study or embryology for anatomy, viz., cross-sectioning the old methods of analysis and classification of the powers and activities of the adult consciousness by bringing in a genetic method, based not upon abstraction like Spencer, but on a copious collection of carefully made and critically sifted objective data. Mr. Ellis's paper is confessedly inadequate, but it is distinctly the first anywhere to present the salient results of researches, mostly American, in the field of child study during the school period.

On the appearance of Dewey and McLellan's Psychology of Number, the editor (*Am. Jour of Psy.*, Vol. VII, p. 300,) expressed disappointment that in a subject so ripe for psycho-pedagogic treatment the authors had failed to take account of a large body of facts and suggestions of more empirical order and which involved very different pedagogical applications. In the second article of the present number of the PEDAGOGICAL

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SEMINARY, Mr. Phillips has presented in concise form this standpoint, which must supplement methods like those of Dewey and Spier before the principle of number teaching can be rightly understood and applied. The matter of this article is of fundamental importance and is sure to command the careful consideration of every one interested in either the psychology or the pedagogy of arithmetic.

Miss Stoker's and Mr. Hancock's brief articles will interest, it is hoped, a limited number of special teachers.

Mr. Swift's article is also a valuable special study.

The reports of the two Child Study Congresses held last May, the first in Chicago, reported by Professor Van Liew, and the second in Bloomington, by Professor Bryan, speak for themselves. Child Study has grown to such dimensions, and has now so many organs, that it seemed to Miss Wiltse hardly possible or indeed necessary to continue her annual reports of its progress.

The articles have in this number crowded the book notices to a smaller space than usual.

For the last few years the Editor of the PEDAGOGICAL SEMINARY has been overwhelmed with letters asking information concerning organization of Child Study work, literature on various aspects and problems of it, advice concerning reading, requests for our 50 to 60 questionnaires, reprints of the 50 or more Child Study articles already printed, etc. Owing to lack of a greatly needed paid secretary to conduct it, this correspondence has been perforce neglected. To meet this need, and in the hope of being of service to the hundreds of inquirers, Mr. Louis N. Wilson, acting publisher of the SEMINARY, whose address is Clark University, now undertakes to answer inquiries, supply circulars and questionnaires and to develop a central bureau of information for all who desire to do work in this field. In this connection he would be glad to be informed of all meetings held, or to be held, to receive any printed matter bearing in any way upon the subject — monographs, reports of school and State superintendents, schools for defectives, State boards of health, etc., — and particularly to learn of books or articles which have been found of special aid to Child Study workers.

SUGGESTIONS FOR A PHILOSOPHY OF EDUCATION.[1]

A. Caswell Ellis, Fellow in Clark University.

After surveying the great attempts of the human mind to build a philosophy of education, one can but be impressed with the fact that all of them together are far better than any one, that each is based upon some real facts and principles of the

[1] This is the last chapter of a work which attempts to make an exposition and criticism of the great philosophies of education, to show their relations, and to point out the larger philosophie and psychologic ideas out of which the various educational systems have grown. These are discussed in order, the Greek educational philosophy, including Socrates, Plato and Aristotle; the Early Christian — Neo-Platonic philosophy and the consequent "other worldly" educational theories; the revolution resulting from the introduction of the new method in psychology and philosophy, as expressed principally by Bacon, Locke, Rousseau, Pestalozzi and Comenius; then the opposite swing of the pendulum arising from the "rediscovery of the inner-life" and the growth of idealism as represented by Kant, Fichte, Schelling, Schiller and Hegel; the reaction coming from the application of Herbart's materialism and advanced psychology; the great eclectic and "romantic" educational philosophy of Froebel; and the evolutionary philosophy of Spencer. The final chapter, here presented, is an attempt to indicate the more important factors to be considered and the lines upon which a future and larger philosophy of education must build, as they are suggested by the recent vigorous work in Anthropology, Biology, Physiology, Psychology and Child-Study.

Such a chapter does not hope to be final; for data is as yet too meagre for much safe generalization, but it is hoped, by such a collection and study of the mass of new facts, gathered here and there in the various fields, that several general tendencies may be clearly shown, as never before, that workers may be stimulated by seeing these valuable results and hopeful lines for research, and receive such suggestions as will help to better direct and shape future experiments.

The writer wishes to express his very great indebtedness to his colleagues here, who have so cheerfully and generously turned in to him the cream of their work of years in various fields of original research — often before their own papers were published. Their suggestion, encouragement and criticism have been of great aid. There is hardly an idea presented that has not sprung from or been developed by suggestions from Dr. Hall, to whom I can give due credit only by saying that without his inspiring suggestions in lecture and conference the work would have been impossible. He is not, however, responsible for this crude work and would doubtless not agree with some of the views here expressed.

human soul,[1] none satisfy all. There is, as yet, no philosophy large enough to contain or explain all the facts of the psychic universe, and until this is possible no philosophy of education can be complete.

It does seem that it would be profitable now to make a careful comparison and combine the undoubted truths of all these past philosophies, and to suggest briefly the lines upon which the more recent discoveries in biology, physiology, anthropology, psychology, and child-study indicate that a larger and truer future philosophy of education must be developed.

The Nature of Man as conditioning Education. Whether man is considered to be by nature primarily good or bad must ultimately condition any theory of education. With the knowledge at hand in the past centuries, it is hardly to be wondered at that no thorough discussion of this question was made. First comes the church dogma of the natural total depravity of man; then varying forms of the philosophic concept that a certain faculty, generally the reason, is divine, while another, generally the feeling, is devilish; then the Kantian idea that man is primarily neither good nor bad; and, finally, the worshippers of nature, with Rousseau and Froebel, declare that there is only good in man.

Certainly, each of these theories of the human soul must demand a radically different theory of education. Since all of them survive, all must have some basis of truth.

A rational and scientific theory of human nature can neither accept, in its usual meaning, the church doctrine of the fundamentally evil nature of natural man, nor can it agree with Froebel and the worshippers of nature, in saying that there is naturally only good in man. This confusion is brought about first by not recognizing the relative nature of what is good. Characteristics that in one stage of human development were necessary and good, may from the changes in a later, higher stage of development, be then bad. That human nature is gradually reaching a higher and purer stage of development shows that, fundamentally, man is created by God with the

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It is hoped to bring this work fully up to date at the publication of the entire volume next year, and the author cordially invites personal information of future work and of such recent reports as have escaped his notice, bearing in any way upon the problems here discussed or upon related questions.

[1] The word *soul* is used in this chapter instead of *mind* as a convenient term to include the entire activities of intellect, feeling and will. It matters not for our puposes here whether readers interpret it as a transcendental entity of some kind, or as a "stream of thought," or complex of associations. The term *mind* is not used, since this term would suggest to a large body of readers merely intellectual activity.

greater tendency upward, or toward the good; but if there is any truth in the doctrines of heredity and in the evolutionary theory of the fundamentality of the fierce and selfish struggle for existence in past ages of development, then man has inherited a disposition that is in the light of the later developed and higher Christian altruism fundamentally selfish, and hence, from this point of view, bad, however useful it may have been in the race, or may even be now to bridge over certain undeveloped stages before the higher altruism is possible. These facts can hardly be denied, and it is from this standpoint, with this view of the soul, that education must approach the child. This embraces the truth of Froebel, and yet does not ignore the no less potent truth of the older Church dogma. If we take the view that feeling in man is but the psychic extract or residuum of past habits and intellectual practices of the race, then the philosophic concept is included, or, rather, modified to meet the demands of modern science.

Basing education upon this apparently unquestionable foundation, the first and primary duty of the educator is to give the widest and freest possible scope to the natural unfolding of all human potentialities consistent with self preservation, believing in the fundamental tendency of man upward, to look forward to a plane of human development not yet known, and to keep out of the way of the tender buds of developing humanity, with the firm faith that they may grow up to a higher air and purer sunshine than we can now supply.

Secondarily, the educator, knowing the history of the race and the laws of heredity, must ever watch the outcrop of those hereditary tendencies that belong to an age gone by and point to a reversion, or retrogression from the present high scale of being. Upon the immediate recognition and the proper treatment of these tendencies depend the success of education, the weal or woe of human life. Thus, the consideration of human history is all important in the education of man, but cannot set the standard or show the goal. It must fix the lower level, it must guide in elimination, but only a knowledge of a developing human soul and a sublime faith in the divine potentialities of man can furnish the primary motive of education worthy of a God-given and developing race.

Any utilitarian or economic ideal is from this point of view unworthy; to make it the end of education to prepare the child for the civilization and society in which he moves is low. This does not refuse to recognize that psychologically the only way to develop beyond the present stage of society is first to fully develop up to it; but it does contend that a philosophy of education which makes the chief end of education to be the preparation of men to fill the various niches in the present

social, political or economical life, sets its face toward a deadening past, and fails to measure up to its possibilities, in not giving an all-sided development to the human potentialities and leaving room for the growth of every latent power, with the belief that there is far more yet in the human soul than we can understand or present civilization give adequate expression. Rest assured that he who has developed the many-sided interests of his own nature will be at the same time well fitted to take his part in what is worthy in the civilization around him and lead it to a higher plane.

Prevailing Educational Inadequacy. In spite of our boasted progress, and there has been remarkable progress in the last decade, the whole plane of education is narrow and teaching tinged with a low and unworthy utilitarianism, which colors our whole American civilization.[1] It is not pleasant to contemplate, but it is true that the educational efforts of our schools are almost entirely directed towards the cultivation of those intellectual capacities which give their possessor power over his fellow man, or ability to heap up the goods of this world, by handling the forces of nature.

The larger part of the pupils leave the schools with no higher aim than to outstrip their neighbors, not to help them, in the pursuit of the comforts and luxuries of life. The better schools do indeed stimulate their pupils to emulate the brilliant thinkers, warriors, statesmen, philosophers, who have heaped up power and treasures of intellectual fame, but why are not the great hearts and souls of the world also set before the students, why do we not give a broad development also to the emotional and volitional sides of life, cultivate more normally the æsthetic, the ethical, the religious sides of human nature? Education seems verily intellect mad.

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[1] Such a statement cannot, of course, claim scientific accuracy, though experience in several sections of the country and consultation with many others of larger experience leave no doubt in the writer's mind that this is true. Hattie Mason Willard ("Children's Ambitions." Studies in Education, p. 243,) found by tests of more than a thousand children in several parts of the country, that by far the larger number of boys said they were influenced by considerations of money in choice of ambitions, while it was the second highest motive with the girls. Will S. Monroe ("Children's Ambitions," N. E. Jour. of Ed., June 28, 1896) found a similar condition of affairs in his study. Chas. H. Thurber and J. P. Taylor, in "Children's Hopes" (Report of State Supt. of Pub. Inst., N. Y., 1896, pp. 992–1012), show that of 2,000 children examined, the reason given for choices of their ideal occupation were as follows: "to earn money," 25% at 7 years of age, 52% at 12 years, then decreasing to about 30% with adolescence; "I like it," 45% at 7 years; 32% at 12 years, decreasing then to 20% during adolescence; "It is nice," average about 12% all the time. These three motives most prominent in New York children certainly do not indicate lofty ideals.

We seem to forget that if we should succeed in keeping everybody in a comfortable house, with plenty to eat and disease almost eliminated, we would then just be on a level with the beavers and ants, as Benn well says. Intellectual force and rational power are surely high and noble attainments, but cold reason cannot alone handle many of the deeper problems of life, and there are depths of the soul to which it gives no adequate expression.

The great danger to our civilization and to democratic government is that the goods of the country are being heaped into the hands of a few men possessing peculiar ability, and the great mass of humanity are yearly becoming poorer, more unable to care for themselves and more jealous of those favored few. This we are trying to remedy by furnishing to the poor man's son an equal opportunity for education and preparation for this grab-game of life as is furnished the rich man's son. Thus it is hoped by equalizing the talent, that each will be able to get a share of the world's goods more commensurate with his needs. Such a result will never come from the present system of education. Equal education can never equalize ability, and, furthermore, the educated son of the poor man is seen in experience to be equally oppressive with his accumulated wealth and exposed to far more jealousy and hatred from the populace. The root of the whole evil lies in the kind of education given to rich and poor alike. The utilitarian and money-getting, so called "practical," side of life must be balanced off by giving in the schools a deeper appreciation of those spiritual elements in man's nature which alone distinguish him from the brutes. They must feel that there are inexhaustible stores for the human soul, far beyond mere wordly goods or intellectual possessions, and that this truer wealth can be shared by every one to his full capacity without limiting the supply to his neighbor, that of this wealth it may be truly said that he who scattereth abroad increaseth. The full breadth and depth of the human soul must be better touched by our educational efforts, and the abnormal amount of attention given to the logical, intellectual faculties be balanced by a more sane development of those no less human and God-given powers which so potently affect life and character, and whose proper development alone can make the sane and wholesome life. In a word, full unity and balance of the human soul should be maintained and the whole man educated.

No better evidence of the one-sidedness of our educational systems could be presented than the fact that practically every effort of the whole pedagogical world is bent upon devising systems of study and methods, and formal steps for communicating a fund of human knowledge to the children in the

shortest possible time; the test everywhere is facility in passing a series of fragmentary, formal examinations, while few think it worth while to look outside the self inclosed circle of intellect, or cease spinning round in the squirrel cage of their own little system to see whether anything is left outside, or whither the whole movement is tending. It is only a few, therefore, that think it of any value to go down into the philosophic principles that underlie and condition our present systems, or see the necessity for a new examination of the human soul in order that no jot or tittle of its possibilities may be neglected in the educational endeavors.

Factors in Determination of Course of Study. From the standpoint of modern biology and psychology, the course of study cannot be properly determined from an examination of history or of the present needs of adult life. Education seems destined to undergo the same radical and life-giving change of standpoint that biological science has just begun to experience. The examination of the preserved dried bones of the past and of the disjointed cadaver, while still important, is yielding to the study of living tissue and, above all, of growing embryos. Never did the secrets of growth and development open their truths till the careful scientist rose above anatomy and laid the living, developing tissue and organism under the microscope. The composition and laws of living tissue are seen to be not at all those of dead matter; the growing embryo is a far different being from the parent, showing many varied laws and phases of development, all differing from the adult and demanding different food and treatment.[1] Just so is educational psychology beginning to see the shortcomings of the dried systems of the past, and of adult psychology, and is placing the living, growing children under its scrutiny, with results that give every reason to believe that here will be found at work psychic forces and principles of growth that are lost to adult years, as much as are the primitive gill slits and fœtal hair of the embryo.

From this point of view, the evidence begins to show that soon the entire curriculum will have to be reconstructed, not with a view to the needs of adult life, but with a view to the needs of the growing organism at each stage of its varying development, the proper food and nourishment at one stage having no necessary logical connection whatever with the requirements of later stages, or even being a positive poison if given after that period — growths probably being demanded at certain periods which must later be sluffed off, absorbed, or transformed.

The problems of pedagogy are shifting from a search for the

[1] See Minot — "Human Embryology;" Ernst Haeckel — "Anthropogenie."

shortest method of giving the knowledge supposed to be necessary for adult life, to an effort to find the outlines of the different periods of psychic development, their demands, laws of growth, and relation to succeeding stages.

Recapitulation Theory. The philosophic speculation of Kant, Herbart and others that the process of development of the individual is parallel to the development shown in the race, and that the culture material utilized by the race in each stage of its upward growth is that best suited to children in analogous stages of development, has been given some scientific basis by the recent work in anthropology and child-study.

This theory while found in the main true, does not hold in the crude way that the early curricula of the Herbartians would indicate. Former ideas, both of the savage and of the child, have undergone a great change on account of a better knowledge gained of each. This knowledge is being enlarged rapidly now, and pedagogy may hope soon for light enough for the working out of this theory in sufficient clearness to give a general outline to the whole course of study.

Parallelism.[1] Many theories have existed with regard to the child: First, the child is equal to primitive man; "Human nature is generally akin . . . and the motives of an adult barbarian are very similar to those of a civilized child," says Francis Galton; Second, the child physically and mentally does as the race did; Third, the child is equal to genius. Confucius and Coleridge held this. The youthful Messiah stories so common are said to be a product of this. "Genius is born, not made." The spontaneity and direct mental habits of each, the skipping of logical, conscious processes in thought by children and geniuses, give color to this theory; Fourth, the child is equal to woman. This is primitive in origin, specially prevalent in the Orient. Women and children are sociological equals among savages; Fifth, the child is equal to the alien, or mentally deficient. Solomon speaks of the foolishness of babes. The old proverb, "Children and fools have many lives," expresses this. It is true that acts perfectly normal in a child would indicate insanity in an adult; Sixth, the child is equal to the criminal. The total depravity dogma of the church is one expression of this. The apparent cruelty and lack of high ethical ideals in children furnish a basis for

[1] For this portion of the work I am greatly indebted to the lectures of Dr. Alex. F. Chamberlain, of Clark University.

For a different discussion of this topic of parallelism see the second Year Book of the Herbart Society. Baldwin's "Mental Development" has the most interesting, suggestive and scientific treatment the matter has yet received. This needs now, however, to be rewritten, incorporating larger data of anthropology and child-study.

this theory; Seventh, the child is equal to the aged. The Greek saying, "Men are twice children," or the expressions "second childhood," etc., the old notions of "fountains of youth," "elixirs of life," etc., are all indications of such a conception. Some children have recently been found to believe also that old people shrink away again to the size of infants.

As to the theory of parallelism between the child and primitive man, most recent returns would indicate that:

1. In emotional life, fear, anger, shame, impulsiveness, etc., the parallel is not proven, except in most general terms.

2. In mental content there is a notable parallel, but both children and savage races vary among themselves greatly. They both, however, reason very largely from analogy.

3. The music of each is very similar.[1]

4. Both are very susceptible to hypnotic suggestion, and imitation plays in the lives of both a tremendous role.

5. The games and amusements are similar, and the more thorough investigations now indicate that the savage is full of the spirit of play, and appears silent, stern and morose from a very childlike reserve before the ordinary visitor.

6. The use of idols, fetishes, toys, etc., by primitive peoples is well paralleled in the child's doll and other toys.

7. The multiplicity of dialects and the general instability of speech among savage peoples is well paralleled by the instability and the mutations characteristic of the speech of children, and by the special languages they sometimes invent. In scribble writing and in drawing they show considerable similarity.

8. The powerful imagination and lack of regard for truth, specially when dealing with persons disliked, present a striking parallel, as does the holding of one ethical code for friends and another for other people.

9. Very interesting and striking is the natural developing among boys of sociological laws, as reported by Johnston,[2] paralleling the growth of law in the race; first of common land holding, then of individual ownership, next of monopoly of lands, and finally the rise of socialism clamoring for redistribution—all of this occurring, not because of any moral or ethical ideal whatever, but being first forced upon the weaker by a few stronger boys and then adopted by common agreement and perpetuated by custom.

Likewise, the development of the sense of law and justice,

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[1] Consult "Rhythm," by T. L. Bolton, *Am. Jour. of Psychology*, VI, 2, and "The Tshi-speaking People of the Gold Coast of West Africa," by A. B. Ellis, Chapter on Music.

[2] John Johnson, Jr. "Rudimentary Society Among Boys;" Johns Hopkins University, Studies in Historical and Political Science, Second Series, XI.

and of the ideas of punishment in children, as reported by Barnes,[1] follows very closely the same development in the race; first, of undiscriminating severe corporal punishment, mostly from vindictive personal reasons, then of discriminative punishment for the protection of society as a whole, and, finally, with the added purpose of reforming the criminal.

Periods of Development. The few studies made of the physical development and of the contents of the minds of children, their sentiments, desires, etc., at different ages, indicate quite clearly at least three widely differing successive phases of development in every child, each with characteristics peculiarly its own and demanding very different methods of both physical and mental training.

These periods are, roughly, childhood, adolescence, and manhood,— childhood extending to the period of pubescence, with its marked physical and equally marked concomitant psychic changes; adolescence verging into manhood as this vast psychic upheaval quiets down upon the completion of growth and the full development of the psychic and physical organs for the battle of life.

These very apparent general periods have often been marked before by the philosophers, but a knowledge of their real content and meaning for education is not yet fully attained, though recent study, particularly of very young children and of adolescents, has brought out much that is of the greatest importance for education.

The age of childhood is further divided into two greatly differing periods, from birth till about seven, and from seven till puberty, but that these demand different treatment from teachers is not yet indicated.

Physical Development. From birth until about the seventh year the growth of the body is very rapid, and the sense organs then reach practical perfection. The works of Bowditch, Kotelmann, Pagliani, Key, Hertel, Erismann, Hansen, and Roberts,[2] all, when due allowance is made for quite small variations on account of racial, climatic and other influences, agree in showing that boys grow slowly from seven till about thirteen, when a rapid acceleration in the rate of increase in height takes place and lasts until the period of puberty is past at about sixteen, when it drops to a slower rate even than before the pubertal shoot. In weight, likewise, the rate of yearly increase is extremely small from seven till about thirteen, but is greatly accelerated from about thirteen to seventeen. Girls exhibit the

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[1] Earl Barnes. Studies in Education. See also notes p. 176.

[2] See "Handbuch der Schulhygiene," Burgerstein und Netolitzky, p. 284, for complete tables of all except Roberts and Hansen.

same phenomena except that increase in height begins about two years earlier, at near ten, and continues until fourteen, while the unusual increase in weight begins about twelve and does not cease until fifteen or sixteen. The boys reach physical maturity hardly before twenty-four years of age, while the girls are physically mature at about eighteen.

Brain Growth. The brain at birth is six times as large in proportion to the size of the body as it is in adult life,[1] weighing about 372 gmms.; all the nerve cells ever to be in the brain are present, but only a very few are developed to functional maturity, as is shown by the small number of medullary sheaths in the cortex.[2] They develop, however, with incredible rapidity, first over the areas for vision and then the other sensory-motor areas, and last of all are developed the areas for association. While there is every reason to believe that this increase in medullation and growth of association fibres goes on, progressing from the fundamental to the accessory parts of the organism, till about forty-five years of age,[3] yet conclusive evidence for this on the neurological side is still wanting; for, as Flechsig says, the brain is so fully medullated by the tenth month in all areas that it is impossible with present methods to study the later medullation accurately.

Donaldson,[4] quoting Seguin, says that the centers for movement of proximal joints are developed before those for the more distal ones, and it is generally accepted by neurologists[5] that the development does proceed from fundamental to accessory nerves.

This, apparently, must be based upon the fact that the embryo follows this general order in its development, and that the nervous system breaks down again in the reverse order, or from accessory to fundamental, and upon inference from the fact that young children are unable to properly co-ordinate movements requiring the adjustment of small muscles, as Hancock has shown.[6]

It is known that the motor nerves of the spinal cord are

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[1] See Chapter X, p. 727, by Donaldson, "American Text Book of Physiology," edited by Howells. The brain makes up 12% of total weight of body at birth and about 2% in adult life.

[2] Vulpius. See also "Growth of Brain," by H. H. Donaldson, and "Gehirn und Seele," von Dr. Paul Flechsig, Leipsic, 1896.

[3] H. H. Donaldson, Growth of the Brain, p. 244; or Kaes, Archiv. f. psychiat. u. Nervenkrank. Bd. XXV, 1894.

[4] Donaldson, "Growth of the Brain," p. 355. Seguin, "Archives of Medicine," 1879.

[5] Ross, "The Diseases of the Nervous System," Vol. I, pp. 68–70.

[6] John A. Hancock. "A preliminary Study of Motor Ability," PED. SEM., III, 1.

better developed than the sensory at birth,[1] and that the child at birth is practically a sensory-motor reflex animal, with only the spinal cord and central gray masses, of the brain, and parts of the cortical areas for the special senses, developed to functional maturity. The development is nothing like complete even here, as Kaiser found over twice as many developed cells in a given area of the cervical enlargement of the cord at fifteen years as was found at birth.[2] The growth of the peripheral sense discrimination soon puts the infant ahead even of the adult, but the central discrimination increases gradually even through adult life.[3]

At three years of age the brain is two-thirds the weight of the adult brain, and some cells in all areas are seen to be developed, though not by any means all cells in any area. The gross weight of the brain increases from 372 gmms. at birth to over 1,300, or within 100 gmms. of full mature weight by about the seventh year. From then until about the fifteenth year, when it reaches its maximum weight, the growth is slow; what happens during adolescence and later is not well studied, and one can only say that the number of medullated fibres increases until about forty-five, when they tend to gradually decrease. All this period is probably given to growth of new connecting or association fibres, and the completion of the sheaths of those begun in early life. That this process is partly due to and dependent upon the effect of external stimuli is shown by the excessive number of granules and partially developed cells in the defective areas of Laura Bridgman's brain.[4]

The great work the neurologists must do for pedagogy is to push this research further and ascertain: first, what is the sure sign of functional maturity in a certain brain area, and, secondly, in what order the different areas reach such maturity as to profit most by those external stimuli that seem to be necessary. Then we might cease injuring unripe organs by too early use, and give those that have reached functional maturity the needed stimuli while still in a plastic condition.

Development Diseases.[5] The various periods of development in the structure of the body are marked again by characteristic concomitant diseases, mostly of neurotic origin.

After the formative failures of intra-uterine life, probably

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[1] Ambronn and Held, His. Archiv. 1896, Heft. 3 and 4.

[2] Kaiser, Die Functionen der Ganglienzellen des Halsmarkes, 1891. Donaldson, Growth of the Brain, p. 164.

[3] Czermak, Gesammelte Schriften, Leipsic, 1879. Donaldson, Growth of the Brain, p. 344.

[4] Donaldson, Growth of the Brain.

[5] These lists of diseases of the different periods are taken almost literally from Clouston, The Neurosis of Development, specially pp. 11-12.

due to deficient trophic innervation, such as hair-lip, cleft palate, genetous idiocy, etc., and after the severe crisis of birth and readjustment to new mode of life are passed, then comes the very rapid growth of the brain from infancy till seven or eight years of age. This is a period of dentition, of rapid special-sense education, and motor co-ordinations, and speech development, and is liable to be accompanied by convulsions, squint, stammering, night terrors, liability to high temperatures, and delirium at night with temperature 99 to 101°, infantile paralysis, tubercular meningitis, hydrocephalus, rickets, deaf-dumbness, some varieties of idiocy and imbecility, with rare cases of mania and melancholia, and other less frequent diseases. These are all connected with the immense brain growths, and the development of certain brain functions at that time, such as those of speech, muscular co-ordination, equilibration, special-sense organs, etc.

The next period is when muscular motion becomes co-ordinated with emotion, from 7 to 14 years of age. This is a period of very slow growth in brain bulk, but probably rapid medullation of association fibres, though sufficient neurological data on this are yet wanting. Then arise chiefly chorea, some forms of epilepsy, somnambulism, megrim, asthma, myopia, convergent strabismus, etc.

The next period is marked by the onset of reproductive capacity at puberty and its gradual perfection during adolescence, with the trophic, motor, emotional and moral developments accompanying this. The exact neurological changes here, too, are not yet discovered. At this period arise such diseases as certain forms of emotional and irrational willfulness and moral perversion, immorality, impulsiveness, stupidity, eccentricity, hysteria, epilepsy, megrim, Friedrich's disease, and above all adolescent insanity, with occasional dipsomania, frothy religionism, perverted sexual instincts, unfounded aversion to relatives, or to society, some joint diseases, acne, nasal pharyngeal polypi, acute rheumatism, etc.

This period of adolescence is certainly the focal point in life. Here the organism has reached that period where it may perpetuate itself, and the tribunal of nature gives it a severe testing before deciding that it shall pass through this stage. This is the time when the last struggle takes place between the rival qualities in heredity. Here the unsound heredity is most liable to show itself, and again here the sound heredity may fight its final battle, uproot the childish diseases of development and start the organism on the road to healthy life. Key has shown that, of 19,000 children examined, chronic diseases were better resisted at the period of maximum growth than at any

other,[1] and Hartwell has shown that, among Boston school children, fewer deaths occur at this period than any other;[2] so that the rule is commonly accepted, that the period of maximum growth is the period of maximum power to resist disease. Lancaster[3] also has evidence that this is true when the maximum growth comes after puberty, whereas if it comes before that time, many of his cases indicate that it is liable to be accompanied with various nervous, digestive and eye troubles, insomia or bad dreams.

Puberty arrives in boys at about 16 and about two years earlier in girls.[4] This is accompanied by the growth of the pubertal hair, and in girls the enlargement of the mammary glands and rapid broadening and erection of the pelvis. There is higher blood pressure in all the arteries, except the pulmonary, which has less. Temperature is also slightly increased.[5] Lancaster has also found several cases in which striking rapid changes occurred during this period in the features and facial expression, the child changing a stub or straight to a Roman nose, or dropping other features of the mother and taking on those of the father, or *vice versa*. The many cases collected of this are certainly of interest and have led Mr. Lancaster to uphold the theory that here at the completion of brain growth in adolescence there is a second struggle between the paternal and maternal potencies, each striving to fix itself, often resulting in readjustment because of the exhaustion of some potency previously victorious and its consequent displacement by the potency from the other parent—this struggle being the great exciting factor in adolescence. This theory needs more evidence, but is certainly of interest.

Mental Development. Noticeable as are the physical changes during these periods, the mental characteristics are no less distinct, as has been shown in the following investigations.

The first psychic activities are largely instinct-feelings with very vague accompanying ideas. The child does not learn even what his own body is till after two years old, as Sully shows. It was clearly shown in the study of "Dolls"[6] that young

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[1] Burgerstein, Axel Key's Schulhygienische Untersuchengen. Hamburg, 1889.

[2] E. M. Hartwell, Report of Director of Physical Training. Boston, 1891.

[3] E. G. Lancaster, The Psychology and Pedagogy of Adolescence. PED. SEM., V, 1.

[4] Charles Roberts, "Physical Maturity of Women." Mr. Lancaster finds in 200 cases examined that boys are earlier than this would indicate.

[5] Dorn Blüth, Gesundheitspflege der Schuljugend, gives a careful account of the physical changes at puberty.

[6] A. Caswell Ellis, and G. Stanley Hall, "Dolls" PED. SEM., IV, 2.

children fail entirely to distinguish subject and object and, even at seven years of age, may attribute their own feelings and desires to other objects. Their powerful imagination[1] and strong feelings master them so that they do not distinguish clearly between the real and the imaginary, and until they are four or five often do not know that their dreams are not realities. The line between feeling, will, and intellect is hardly distinguishable, as was shown by their utter inability to see in their dolls anything but what they felt or desired about them. This confusion begins to clear up after five or six, but the stronger impulse to attribute to everything else the child's own feelings, or animism, is still present at seven and falls away only slowly till adolescence. The child seems to be as thoroughly animistic as a savage could be in present environment, as practically all the studies of children show. That the child personifies everything and is so imaginative, Sully shows, does not prevent him from having even at the same time a strong, but very fluctuating, power of observation. Correct and full observation, however, is a slow growth. At this period of life children are in an almost hypnotic state of suggestibility, as is shown by Baldwin,[2] Small[3] and others.

Darwin,[4] Preyer,[5] Perez,[6] Sully,[7] Lombroso,[8] Compayré[9] Hall, and Burk, have shown the many animal and savage characteristics of young children, such as their utter selfishness, lack of regard for others' feelings, their teasing and bullying propensities, fears, superstitions, lack of regard for truth, mimicry, lack of correct idea of death, even their sympathy and pity are largely imitations and are well paralleled in animal and savage life.

Miss Sissons[10] noted that of all the spontaneous school yard plays of kindergarten children, the dramatic and representative plays and those having great physical action were predominant. In the tremendous role that imitation plays in children Miss

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[1] On imagination, see W. H. Burnham, "Individual Differences in the Imagination of Children." PED. SEM., II, 2. Also, F. Queyrat, Le Imagination et ses varieties chez l'enfant.

[2] Mark Baldwin, Mental Development in the Child and the Race.

[3] Maurice H. Small, "The Suggestibility of Children." PED. SEM., IV, 2.

[4] Charles Darwin, The Expression of the Emotions in Man and Animals.

[5] Preyer, The Infant Mind, and The Mind of the Child.

[6] Perez, The First Three Years of Childhood.

[7] Sully, Studies of Childhood.

[8] Lombroso, L'Homme Criminel. "Criminal Instincts are general in children."

[9] Compayré, "L'Evolution de L'Enfant."

[10] Genevra Sissons "Children's Plays." Studies in Ed., p. 172.

Frear[1] noted that they loved specially to imitate adult activities rather than adult words.

The colors preferred by young children are the strong ones, and the more violent contrasts are the most pleasing. They show little, if any, appreciation of real art, preferring decidedly the common colored reproductions to the most artistic black and white originals.[2]

The productive art instinct awakens very early, and recent study shows it to be, as Froebel said, a continuation of gesture. After the early scribble stage it passes very soon into the symbolic and representative stages; children showing more interest in the art production than appreciation for art till about the eighth year, when Lukens[3] finds much evidence that the interest in the study of art or observation of artistic production forges ahead and the early interest in production is lost. This falling off of interest in production may be permanent, but if not, it remains far below the interest in observation and appreciation of artistic productions till well into the period of adolescence.

The child's interest in causality[4] is awakened very early, being present in all children examined before three years of age, the boys being more precocious and persistent than the girls. Their questions of "why" are most frequently about natural phenomena, motion, animals, and religious subjects. Practically all children show a religious interest before seven years of age.

Binet, Barnes and Shaw found that almost the only interest which young children have for objects is in their use and action, with little or no interest in their substance or qualities. After this period they gradually get interested more in the activity and motion, and then in what it is made of. Barnes found that interest in classification is very small till seven, rises slowly till ten and rapidly then till it reaches adult proportions by fifteen years.[5]

Sully, Mrs. Barnes, Brown,[6] in fact, all students of children,

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[1] Caroline Frear, "Imitation, A Study Based on E. H. Russel's Child Observations." PED. SEM., IV, 3.

[2] M. V. O'Shea, "Interests in Childhood." Child Study Monthly, Oct. 1896. Baldwin found blue to be the favorite color, but his method was faulty. Most observers give yellow as the earliest favorite.

[3] See foot note 5, p. 185; also M. V. O'Shea in Proc. N. E. A., 1894, p. 1015.

[4] See Sully, also Anna L. Davis, "On Children's Interest in the Causal Idea." Child Study Monthly, Sept., 1896.

[5] Alfred Binet, "Perception d'enfant." Revue Philosophique, 1890. Earl Barnes, "A Study of Children's Interests." Studies in Ed. p. 203, ff. Edward R. Shaw, "A Comparative Study on Children's Interests." Child Study Monthly, 1896.

[6] Elmer E. Brown, "The Child's Interest in Historical Biography and Narrative." Journal of Ed., Feb. 7, 1895.

agree that the preponderating literary interest of young children is in fairy and folk-lore stories, which lasts with at least half the children till ten years of age, when it rapidly declines almost to extinction by the thirteenth year, with a possible rejuvenation later from another standpoint. Miss Vostrovsky,[1] in a special study, found love lore not mentioned till the tenth year, and at this same period the children suddenly grow critical and lose interest in the fairy stories. Brown found that for California children legendary heroes, pioneers, and heroes in history, awakened little interest till the eleventh or twelfth year, when they were the predominating interest. In a study of favorite books of children at various ages Mr. John C. Shaw found the following to be the five most generally liked, given in order of preference: 3d grade, Grimm's Fairy Tales, Alice in Wonderland, Black Beauty, Andersen's Fairy Tales, Five Little Peppers; 7th grade, Scottish Chiefs, Rose in Bloom, With Clive in India, Six Girls, Huckleberry Finn; 2d yr. High School, Donovan, Ramona, Scarlet Letter, Prince of India, Rob Roy. Lancaster[2] found in his study of adolescence the following authors preferred at that period, given in order of preference: Poets—Longfellow, Tennyson, Whittier, Shakespere, Holmes, Bryant, Mrs. Browning; Novelists—Scott, Dickens, Alcott, Eliot, Hawthorne, Roe, Stowe, Cooper. Both these studies are too limited for scientific generalization, and the spontaneity of the reports of the children is interfered with because certain of these works are taught now in so many schools; but taken with other works in child-study their import is plain.

Of stories interesting to young children, Miss Vostrovsky found them most interested in the early period in the action and the names, while feelings, sentiments, æsthetic details and moral distinctions fill a small place. Stories with the particular human interests were preferred and specially those about children.[3] Miss Holbrook reached similar results, through study of things read by children.[4] In this the decided presence of the feeling

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[1] Clara Vostrovsky, "A Study of Children's Superstitions." Studies in Ed., p. 123, ff.

[2] E. G. Lancaster, The Psychology and Pedagogy of Adolescence. PED. SEM., V, 1.

[3] Clara Vostrovsky, "A Study of Children's Own Stories." Studies in Ed., p. 15, ff.

[4] Agnes Sinclair Holbrook, "Study in Reminiscence." Studies in Ed. p. 58, ff. Pathos with a gladness of relief were the emotions mentioned most often. Evening appeared the most impressionable time, often with the open crackling fire and silence at the time mentioned. Colored illustrations also were conspicuous in memory. The animal Bible stories such as Jonah and Daniel were favorites. Almost no reading-book stories were mentioned. Book titles and persons' names were among the most prominent things remembered.

or emotional element is noticed, which certainly is more in accord with the writer's general observation than Miss Vostrovsky's result indicating that feelings played a small part with young children.

In study of historical interest, Mrs. Barnes,[1] and, in an independent study, Miss Köhler[2] found that it first centered around strong lines of action, a clear presentation of names and places and the relations of cause and effect, and a desire for a truthful record. The last was, however, entirely uncritical, the personal authority of the teacher being all that was desired. Little care was given to the time, the ethical element or expansion of detail. The early interest was largely personal, centering in families and heroes. The larger social interest was not found till the twelfth year, when it rose very rapidly and along with it a strong critical spirit and interest, which till then is lacking. The change to interest in social life and in the search of sources for truth is as decided here at puberty as we will see later it is in religious development.

The power to draw inference, while not found entirely absent at any period examined, was very slowly developed and still weak till the twelfth or thirteenth year when it developed strongly into legitimate and imaginative inference.

Street reports experiments which indicate that children acquire a foreign language more rapidly from eight to twelve than at any other period of life.[3] Shaw found that of 700 Worcester school children examined, the memory reached its maximum very early, boys by the ninth and girls by the seventh year of the grammar school.[4]

A compilation of the works of Hall,[5] Barnes,[6] Sully, Burnham,[7] Daniels,[8] Ellis,[9] Starbuck,[10] and others, indicates that in theological matters children below six usually accept everything told them without question, only translating all of our adult explanations into terms of their own little experience. The spirit world being another home and playground above the

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[1] Mary Sheldon Barnes, "The Historic Sense Among Children." Studies in Ed., p. 43, ff.

[2] Anna Köhler. "Studies in Historical Methods," by M. S. Barnes. Boston, 1896, p. 81.

[3] J. C. Street, "A Study in Language Teaching." PED. SEM., IV, 3.

[4] John C. Shaw, "Memory in School Children." PED. SEM., IV, 1.

[5] G. Stanley Hall, "The Contents of Children's Minds." PED SEM., I, 2. Also reprint in book form by E. L. Kellogg & Co., New York.

[6] Earl Barnes, "Sex in Education," and "The Theological Life of a California Child." PED. SEM., II.

[7] W. H. Burnham, "A Study of Adolescence." PED. SEM., 1, 2.

[8] A. H. Daniels, "The New Life." *Am. Jour. of Psychology*, VI, 1.

[9] A. Caswell Ellis, "The Sunday School." PED. SEM., III. 3.

[10] Edwin D. Starbuck, "A Study of Conversion" *Am. Jour. of Psychology*, VIII, 2.

sky with dollies and pets. Very few and vague questions arise from seven till ten when they begin to criticise and question. This increases now rapidly, reaching its maximum intensity at about fourteen, and declining slowly from that time. The period of adolescence is, however, the period of the greatest religious interest, and the strongest theological convictions are felt from about twelve to fourteen or sixteen. After this, doubts assail strongly and the youths struggle in attempt to harmonize science and religion.

Closely connected with the religious development is that from selfishness to altruism. Young children are all by nature almost completely selfish; from six to twelve a few are unselfish, while all normally improve; but adolescence is marked by a remarkable awakening of unselfishness, a rise of philanthropic ambitions and general social and altruistic impulses,[1] girls leading boys at all ages, except probably at about thirteen.[2] These natural altruistic and social instincts may, however, be completely inverted and adolescence develop an intense selfishness, a morbid hatred of all society, or a great love of bullying and teasing, which is quite common also in a much younger age, as Burk shows.[3] Dawson[4] finds that most criminals in American schools and prisons are found to have begun their career before twenty years of age, and that a large per cent. of the children in the reform schools, very many of whom are adolescents, are sent there on account of stubbornness, or refusal to submit to the usual controlling authority.

Barnes,[5] Miss Darrah,[6] Miss Schallenberger,[7] Miss Frear,[8] Snedden,[9] all approaching the subject in different ways with varying experiments found that children under six or seven have little, if any, appreciation of general laws, but consider personal commands binding, and regard punishment as an arbitrary, individual matter imposed without reference to the social order. They do not themselves discriminate degrees of offences, but

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[1] Alma Patterson, "Children's Motives." Studies in Ed., p. 252, ff. "Children's Hopes," Rep. State Supt. of Pub. Inst., N. Y., 1896, p. 1007–8. In this study only three or four out of 2,000 mentioned religious hopes till twelve; the consideration of death was not seen either till twelve.

[2] Hattie Mason Willard, "Children's Ambitions." Studies in Ed., p. 243, ff.

[3] Frederick L. Burk, "Teasing and Bullying." PED. SEM., IV, 3.

[4] Geo. E. Dawson, an unpublished manuscript.

[5] Earl Barnes, "Discipline." Studies in Ed., p. 366, and other places.

[6] Estelle M. Darrah, "Children's Attitude toward Law." Studies in Ed., p. 213 and 254.

[7] Margaret E. Schallenberger. PED. SEM., III, 1.

[8] Caroline Frear, "Class Punishment." Studies in Ed., p. 332.

[9] David S. Snedden, "Children's Attitude toward Punishment for Weak Time Sense." Studies in Ed., p. 344.

punish arbitrarily and severely, more with a vindictive notion of "getting even" than with any moral purpose. Street[1] reports that, of two hundred persons studied by him, moral action with younger children seemed more a matter of imitation, and that conscience plays a very small role till after nine years of age and little then till about thirteen. Young children have vague notions or feelings of outrage, or of satisfaction, without knowing exactly why. They submit to arbitrary punishment more willingly now, but less and less so as age advances. Sully says that young children object to all law as implying a restraint on free action. This condition grows more rational very slowly till about the eleventh year, when a great increase in regard for law springs up and develops rapidly, till at sixteen (the highest age studied) seventy-five per cent. of all recognized well its binding force. The child begins now to know what he feels, to recognize the social order, to appreciate the purpose and remedial value of punishment, to punish less severely and more rationally, taking into account somewhat the intentions of the culprit.

Though very indefinitely and incompletely, something of the same order of development was noticed in examining the reports of punishments of dolls by children at different ages.

Clouston, Burnham, Lancaster, all those who have studied adolescence impress upon us the revolutionary character of this period. Here the social and ethical impulses spring to the front.[2] As at the first physical birth the lower animal feelings and instincts, and the special senses are born and develop rapidly to maturity, so at the second birth of adolescence the nobler social and religious feelings, the higher critical and rational faculties are born into the human soul. At this period the emotional activity is intense, often to a morbid despondency or unreasoning joy. The love of nature is strong — not a scientific love of it, but for the quiet, solitary communings. This arises apparently from an intense desire for sympathy. For the same reason, apparently, boys at this period so often love women very much older than themselves. They seem to feel a broader life stirring within them and to grope around in all directions to satisfy this yearning. Lancaster reports that this is a period of interest in music and art, with a strong tendency to philosophize. Impulses spring up here in all directions, expressing themselves now in intense love of the opposite sex, now in fierce religious fervor, or in desires or attempts to do great things, to straighten out or right the order of the universe, to do great acts

[1] J. R. Street, "A Study in Moral Education" PED. SEM., V, 1.

[2] See also "Children's Hopes," by Taylor, Rep. State Supt. of Pub. Inst., N. Y., 1896, p. 1006, ff.

of heroism, or deeds of philanthropy. There seems to be nothing beyond the reach of the wild surging of an adolescent's brain, and future life never rises higher than the level here attained. In this period are glimpsed all the great ideals which direct the whole life, and adult life might be termed the period for picking out and developing some one or more of the vague ideals, aspirations, hopes, of adolescence.

After looking at these facts indicating the several radically differing phases of human development, one must see that any system of pedagogy that does not make the child's development the fundamental fact in the determination of culture material and method of procedure in education cannot hope to escape trampling upon or starving the most precious buds of the developing human being.

The human soul is seen to be too complex, possess too many differing phases of development to be met at all periods of life by any present form or method or system of education.

To be sure, no hard and fast lines, or particular ages of life mark off these periods, and certainly the experiments thus far made are crude in the extreme and often thoroughly unsatisfactory; but all of them together do make it safe for us to say, roughly, even in this, the infancy of child study, that these periods are passed through in this order and with these changes. That far greater clearness and deeper insight will be gained by the combined work of the next few years is a safe and reasonable hope. Child-study is in the period of search for proper methods of working; the data already on hand have cleared the way enough to show what are some of its problems and what sort of questions we must ask nature in our experiments. To get such questions clearly outlined has ever been the first *desideratum* for an advance in science.

Meaning of these Periods. What these periods of development mean for education is a problem that philosophy has forced upon it now as never before.

The greatest problem of all presented by these periods is the relation in the unconscious between these successive stages of development. In the intra-uterine period the embryo is, so far as we can say, entirely unconscious, and the special sense organs and cortical areas do not function at all; yet such a force is generated, or gathered up, in this period that in a few days after birth this whole system comes into function. That all the forces necessary for the rapid development of the first months of life should be generated after birth is incredible. It is well known, too, that malnutrition, improper stimulation, shock during gestation, or accidents at delivery, may any of them produce most profound effects upon the sense life to be developed in the first few years after birth.

Just so, in that second period of childhood, from seven to eleven, the body growth has stopped, the brain growth is nearly at a standstill, and the higher emotional, altruistic and critically rational life has scarcely begun to function—the few scattered cases of apparent function being hardly more than comparable to the reflex or imitative intra-uterine reactions of the embryo ; yet a burst of physical energy and flood of new emotional and intellectual activity show themselves in such rapidity at puberty that the space of one year may transform the whole mental and physical organism. The question is forced upon us then, where does all this force come from, which so suddenly and powerfully surges up at puberty? Can it all be generated during this brief period, or has the organism been gradually accumulating it during all that long period of retarded growth? Do not the forces which break forth at adolescence in new physical functions and higher emotional activity slowly and unconsciously gather during that period of dead-level from seven till eleven, just as the forces for the growth of consciousness and special senses gather during the intra-uterine period? Is there any particular causal relation between the activities of the senses and muscles from seven till eleven and the later higher psychic activities? In what form are those forces that are to come forth later stored away in this period? Under what embryonic forms are the rudiments to appear now that will stimulate the later deep emotion and broad reason? Are the abstractions of later life first developed in the form of symbols, as Froebel believed, and must the child first possess this symbolic form and feed his soul on that to develop this unconscious potentiality for abstract thought up to consciousness at adolescence? Anthropology shows that symbols have played a vast role in the growth of thought in the human race. Froebel's mathematical symbolism certainly seems, however, to have few facts in psychology or anthropology to sustain it; but may there not be a larger and broader symbolism of nature that plays a part in education we little dream of as yet. The psychic powers cannot spring forth full developed from nothing into consciousness. All nature tells us that there must be some preceding, intermediate state out of which they grow.

Education has got to get back of clear consciousness into rudimentary and germinal forms to find what they are and how they are fostered. The feelings, the instincts are the great reservoir from which all ultimately comes, and if we ever intend to be more than mere conjurors and parlor magic workers we must go into this laboratory of soul and see how nature prepares those highly organized compounds of consciousness that are thus at certain seasons thrown out in overwhelming confusion. Until that is done education is a gross empiricism and at best

largely guess work. The study of adolescence has received some careful attention, and though much is left to learn, we do know something of its chief features. Of that period from seven till eleven practically nothing is known. This is now one of the greatest needs in pedagogical psychology. It is impossible to get the full meaning of the earlier period or to understand adolescence till we know what the one results in and what produces the other. If analogy is of any value for prophecy, it will probably be found that the rudimentary form of the adolescent psychoses are not similar at all in form to the developed product. To apply this concretely, that forcing upon young children broken doses of love lore and society of the opposite sex will not at all hasten the development of a healthy adolescent love ; or, that certain juvenile courses in nature-study may even delay or abort the adolescent love, sympathy and feeling of union with nature—and so with religion, science, etc. This whole matter bids fair now to turn out to be a food problem. Take, for instance, the catechism in early religious training. Is not the use of that somewhat as it would be if one discovered that the body was made of oxygen, hydrogen, nitrogen, etc., in certain proportions and amounts, and then took exactly those same proportions and amounts of pure oxygen, hydrogen, etc., and fed them raw to the child? All things now point in pedagogy to the fact that we must take more fully into consideration the digestive and transforming power of the receiving mind. We know what is given to the child, as yet we don't know what he transforms it into before thorough mental digestion takes place. So far as consciousness is concerned, we can see no possible connection between the mental stimuli given the child in the intra-uterine period and those powers that he possesses just after birth. He has been simply taking nourishment through the umbilical cord, and upon this process depends the ripening of those powers of sense. The puppy confined in perfect darkness, away from every sight stimulation, and kept well fed, had his eyes to open and sight to come at the proper time.[1] What now are the rudimentary stages of the special senses in intra-uterine existence, and what stimulation do they need? No one would say that their development would be helped and not greatly endangered at this period by the sense stimulation of later post natal life. There seems to exist a sort of food relation here that is not well understood. So with the activity of that period just before adolescence, it seems probable that the relation which it will sustain to adolescence is this same food relation. It will be seen that it is not at all

[1] H. Held, "Ueber Experimentelle Reifung des Nervenmarkes." Archiv. of Anat. u. Entwickelungsgeschichte. Leipsic, 1896. p. 222.

the plan of nature to prepare the way for the later activity by giving a simple form or broken dose of this activity for a long previous period, but by feeding the organism on such food as it demands and has organs to receive at this particular stage of its development — preparing for the sense activity by feeding the physical embryo on blood, preparing for the higher emotions and co-ordinations of thought of adolescence, by feeding the child upon the somewhat animal emotions and sensuous and muscular activities of the earlier period of natural youth.

If this is what Froebel meant in saying that the full and complete development of one period is the best possible preparation for the succeeding period, then he took his position like a biologist and philosopher, but he applied it like a mystic.

In the present condition of psychology such problems are open to us as they never were before, but much work is yet to be done before any but a speculative answer can be given.

Period from Seven to Eleven. Concerning that enigmatical period of retarded development from about seven till eleven one fact does seem to be quite certain; that is, that it is the period for language teaching. By referring to the diseases of the former period it will be seen that the speech organs have just completed their growth and hence are still somewhat plastic, though ready for work. It is also shown that during this period the verbal memory is good, reaching maximum power about its end, while children now are particularly interested in names. The higher emotional and co-ordinative power and interests of adolescence are not needed to learn words, declensions, and conjugations; so that it is but natural that this should be found, as it has been, the period of greatest facility in learning a foreign language. That intensive study of language should come here seems certain.

That this is also the period for the co-ordination of the muscular movements is a patent fact of physiology. The intense interest in plays[1] and the irrepressible movements, the lack of ability to long concentrate attention on intellectual work, their love of manual exercises[2] all indicate that in this period should

[1] Mr. T. R. Crosswell finds in a study he is making, including about 5,000 children, that 8 to 13 are years of great interest in the traditional games, such as tag, ball, etc.,—ten and eleven being the years of greatest interest. The same is true of the running games, while the love of toys and imitative games comes earlier, and that of such games as cards comes later.

[2] J. P. Taylor ("Children's Hopes," Rep. State Supt. Pub. Inst. N. Y., 1896, p. 1000,) found that of 2,000 children examined the trades were most popular at 7, 8, and 9. "The fact that an occupation deals with tools, plants, or animals, that it means peculiar power over one's fellows, that it gives one a distinguished air and requires something of heroism makes it appeal most strongly to the younger boys."

be begun those manual and artistic studies that require peculiar or delicate muscular co-ordination later in life.

The Early Period. What should be done in that first period of rapid growth is doubtful. Here the senses are to be trained, surely; but whether otherwise the period should not be left to digestion and growth, by following almost any line of spontaneous interest is an open question. The adult teachers are so far removed from the condition of mind of this period that they cannot appreciate it, as they may the later periods, by means of their own reminiscences; and so little is really known of the child's capacities and needs at this time that any *rigid, adult-devised* system from present data seems as liable to harm as to help the child. The safest hope appears to be to trust nature and let children follow largely their own interests, but when we consider their almost hypnotic state of suggestibility it will be seen that this is well-nigh impossible unless the adult exercises considerable care in getting out of the child's way. The further discussion of this is not in place here, nor a very satisfactory settlement on scientific grounds possible from present data. What could be said was given in discussing Froebel.

Adolescence. At the great psychic new birth at adolescence it cannot be doubted that the new forces set free must have fit material to which to apply themselves, lest they become attached to what is unworthy — here the boy should have something better than partial payments and Latin roots; he should study into such larger views of life, and nature and religion as are shown in biology, sociology, history, science, literature, etc. Street[1] found from ten to fifteen to be the period when most children studied by him noted the great influence of a companion or teacher in shaping their moral character.

The intense energy and activity of adolescence demand many and large interests, and if education fails to satisfy these, the force expends itself in dangerous or morbid channels. How this energy is conserved and what interests are established here will determine the future life.

"Core" of Study. Many other minor points are to be gathered from what data are already collected, but these are only a beginning of what the next few years should furnish. The supreme importance of these periods, and their controlling influence in any rational course of study, can no longer be doubted. From this point of view all notions of the Herbartians about a "core" or "cores" of studies must be transformed. The "core" of study must shift with the varying cores of interest and capacity, as they arise in different stages of the natural order of psychic development. There should be no more danger

[1] J. R. Street, "Moral Education." PED. SEM., V, 1.

to mental unity and sanity in this than there is to bodily unity in the developing of some senses and organs years before others. The laws of organic growth are far too subtle to be included within mathematical psychology.

Nascent Periods. These facts prepare the way now for a discussion of the "nascent periods" of psychic development. The chemist knows that just at the point of being set free from its old combination an element may take up more of another given element than it ever can afterward; nascent oxygen, for instance, can take more hydrogen than can ordinary pure oxygen. In physical growth the period of greatest growth in function is birth. All the organs for breathing, eating and extra-uterine life are present for some time before, but suddenly they begin an activity that is tremendous as compared with their previous condition. Food and air now are all important, never again will such large returns result from such small outlay of nutriment. Slight starvation now may mean death. Small neglect or maltreatment now are more serious than they are ever afterwards. Similarly, at the nascent period of puberty proper or improper treatment of the organs then developing has its most powerful effect for good or evil.

In the cultivation of psychic powers, the same importance seems to be attached to their nascent period. If the special senses are not trained in childhood it is impossible to acquire the highest skill later. The emotional and æsthetic faculties must be developed before the passing of adolescence or they never reach perfection. Lancaster[1] found the average age at which great actors, poets and artists did their first famous work was below nineteen, while the great musicians have become noted before ten years of age, pioneers by eighteen and missionaries before twenty-three. The physical and manual training teachers generally claim that it is impossible to ever after gain perfection as wood carvers, gymnasts, etc., if the period of early muscle and nerve growth and co-ordination before and during early adolescence is neglected. There seems to attach a certain plasticity and also a momentum to early stages of any growth that offer opportunity to the educator such as no other period does. Little work of value has yet been done to see, either when these nascent mental periods for different culture subjects are on, or to indicate by what the educator may be guided in attempting to seize all these at the period of maximum capacity for growth.

The safest and only guide now offered is the child's own in-

[1] Dr. Lancaster studied the lives of 100 noted actors, 50 poets, 50 artists, 100 musicians, 100 pioneers, and 50 missionaries. See note 3, p. 171.

terest. Interest is nature's declaration that here is something which fills a want felt in the organism. A few random questions or hysterical kind of enthusiasm, due generally to suggestion or imitation in following a teacher in class, do not indicate anything of the kind or any real interest. And when intelligent men speak of following interests as if opposed to work and to doing all unpleasant tasks, and as if it meant vibrating with every flitting fancy of the child brain, they really appear not to understand what "following interests" means. It is a physical and mental impossibility to follow all interests; but it flies in the face of nature and tramples science under foot to attempt to teach anything for which the child has then no interest. It will be seen under the discussion of "rudimentary organs" that many interests of the child need as careful weeding out as others do fostering; but interest must mean some degree of physical and apperceptive ripeness for the given subject, for how can one be interested in what he knows nothing about. Physiology shows that interest means a quicker pulse and full blood supply to the whole central system.[1] Hodge's work on fatigue shows that no amount of external uninteresting stimulation can tear the nerve cells down with activity as will the normal interests of the daily work of those animals in gathering food.[2] Psychology and child-study have yet much to furnish pedagogy in pointing out the normal interests of each period of life, and the proper method of developing them without causing stagnation from too early satiety on the one hand, or, on the other hand, losing the precious moment of maximum capacity for growth by an early starvation. Herbart first showed the real value of a many-sided interest, but it is left for modern pedagogy to find what these interests are and when and how they develop. His idea of grafting them on, and his "formal steps" by which to develop them, do not cover what the study of heredity, instinct and feeling have shown since, and it seems probable now that even these much loved and more abused "steps," will have to give way, or at least give over many passengers to other more instinctive, less conscious and less logical means of entrance into the mind. Just what these new steps, or what the apparent variety of steps are, is yet too subtle a problem for present data.

Periods of Arrest. Connected probably closely with the inevitable rhythm of the ebb and flow of interest, and just the obverse side, or compliment, of the nascent periods are the periods of decided decrease in rate of progress, or total standstill

[1] H. H. Donaldson, The Growth of the Brain, p. 356.

[2] C. F. Hodge, "A Microscopical Study of Changes Due to Functional Activity in Nerve Cells." (Boston, 1892), Journal of Morphology, Vol. VII, No. 2.

in the process of mastery of any subject. This common experience all have had of beginning some new subject, such as a new language, or athletic exercise and making very rapid progress for a while and then ceasing to improve further, no matter how hard one tries, till a rest is taken or some extra stimulus spurs us to an unusual exertion, when the progress begins again as suddenly as it ceased and rapid improvement is made for another period. Only recently has this matter been studied experimentally, and yet only slightly. Physiological rhythms have been found in practically all physical functions,[1] and the parallelism usually found between bodily and mental phenomena should long ago have set education to work on this problem. Brooks[2] shows that in the segmentation of eggs the progress is not at all even, but consists of periods of apparent rest followed by periods of great activity. Donaldson[3] says of the brain that growth is never general, but accentuated, now at one spot, now at another. All of this gives increased significance to the work of Bryan and Harter,[4] which showed that in learning both to send and to receive the telegraphic symbols the rate of progress went by jerks, and with each student there was a long period of lessened rate of improvement, or no improvement at all, between the rapid rise of the first few weeks of practice and the final rise that gave sufficient facility to do "main line" work. The continuation of the usual exercise per day failed to cause any improvement in work during this rather constant period of no advance till, from no apparent reason, the progress began again; or in some cases the subjects staid at the first period of no improvement for years, seeming to be unable to advance to the required rate for "main line" work, but under extra pressure from the stimulus of threatened loss of job would make an unusual effort and begin at once to improve, when a period of rapid progress followed till a maximum was reached much above "main line" rate.

In writing and drawing and learning to speak, Lukens[5] has

[1] Michael Foster, Physiology.

[2] W. K. Brooks, Studies in Biological Laboratory, Johns Hopkins University, Vol. II, 1882.

[3] H. H. Donaldson, the Growth of the Brain, p. 357.

[4] William L. Bryan, and Noble Harter, "Studies in the Telegraphic Language." Psychological Review, January, 1897.

[5] H. T. Lukens, PED. SEM., Oct., '96, and May, '96. Dr. Lukens has since consulted such experienced teachers as Prof. Miller, of Penn. Mus. and Sch. of Ind. Arts, Supt. Daniels, of Chicopee, Mass., Miss Stoker, of St. Paul, Miss Locke, of Chicago, all of whom have noticed the very striking periodicity mentioned in learning drawing; while a number of professional penmen consulted stated that there was a critical period for practice in penmanship about the time of the outcrop of individuality in writing. The writer is indebted to Dr. Lukens for suggestions, both in his lectures at Clark and in a private letter on this subject.

found similar fluctuations. Clark[1] and Barnes[2] give the same report for drawing. Starbuck[3] finds such a periodicity in ethical development; Phillips[4] is finding evidence for the same thing in the study of arithmetic; Street[5] in language and in moral culture. Whether this phenomenon is due to a normal and inevitable fluctuation in interest and consequent power of attention and effort, caused by the natural rise of other differing interests; or it is based upon some neurological considerations, such as a need of time for the new association fibres stimulated by the new study to get their sheaths fully developed, and the large number of new co-ordinations to get worked over together until they become largely reflex and leave consciousness unburdened longer with them to follow on after new co-ordinations, these are questions of immense significance for pedagogy. A comparison of this with the study of the phenomena of "second breath,"[6] and of conversion,[7] would seem to make it sure that it is short, intense effort which does the great work in education.

Bryan says, however, that unless the normal effort has been kept up faithfully during the long period of no improvement the final period of intense effort will not cause the decided rise in facility in learning telegraphy. This is of great importance, if true, and greater importance if untrue. The writer does not think that control experiments were used sufficiently to give this part of the work proper scientific value. Personal experience in many forms of athletics, and somewhat extended, though unscientific observation, also, lead the writer to believe that in that period of pause in improvement intense and persistent effort is a waste; and that comparative rest, or direction of attention to another exercise, with only enough of the usual work being done to prevent getting out of practice, will give the same result of rapid improvement upon the application of the intense effort again at near the end of the natural period of inability to improve. If scientific experiments prove this true, it is of the greatest importance in the arrangement of the school curriculum. It is a problem that needs and will probably soon have further conclusive study.

These and other facts suggesting the superior power of intense, concentrated, persistent effort over a limited period of

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[1] John S. Clark, Ed. Review, (N. Y.) Jan'y, '97.
[2] Earl Barnes, Studies in Ed.
[3] Edwin D. Starbuck, "A Study of Conversion." *American Journal of Psychology*, VIII, 2, and later studies yet unpublished.
[4] D. E. Phillips, *Am. Jour. of Psychology*, VIII, 4.
[5] J. R. Street, PED. SEM. V, 1.
[6] G. E. Partridge, "Second Breath." PED. SEM., IV, 3.
[7] Jas. H. Leuba, A Study in the Psychology of Religious Phenomena. *Am. Jour. of Psychology*, VII, 3. Edwin D. Starbuck, "A Study in Conversion." *Am. Jour. of Psychology*, VIII, 2.

time, and the work of Bergström[1] and Münsterburg showing the mental waste from interference of associations must soon make the present school curriculum and programme, consisting of a bewildering number of small, scrappy lessons in various subjects piled together each day, yield to periods of more concentrated and intensive study at one time of only a few related subjects.

Rudimentary Organs. As has now been seen on the one hand, that there are in man natural upward tendencies and capacities, which have their own law of development, and each its own peculiar period for coming into life, which should determine the school method and curriculum; so, too, it can be well shown that many downward tendencies crop out in man that are the hereditary legacy left to the organism by the long ages of primitive or animal ancestry. The appearance during the process of growth in a higher organism of physical or psychic characteristics belonging to a lower form in the line of evolutionary development is a common phenomenon, lately much discussed under the term "rudimentary organs." Comparative anatomy and embryology have long ago brought to light these rudimentary organs, belonging really to past ages but brought down in our present bodies, though of no apparent use, such as the semi-lunar fold at the internal angle of the eye, representing the third eyelid of the marsupials; the useless and often troublesome vermiform appendix, representing an enormous organ in the herbivora, "and in the koala attains a length three times that of the body;" the useless ear muscles; the pineal gland, now of unknown use, the remnant of a prominent body in the brain of lower animals, probably once a central, superior eye; the pituitary body, certainly rudimentary and probably representing the primitive mouth or a primitive sense organ of the ancestors of the vertebrata. In man there are now discovered many dozens of these rudimentary organs still present in the adult body; while in its various phases of growth the embryo presents a much larger number of ancestral traces, which pass away or are transformed before adult life is reached.[2] Thus the human embryo has, among other forms, that of the young of the fish with primitive gill slits, ventral yolk sac, etc., later passing into forms indistinguishable from the young of the lower vertebrates, and finally taking on distinctly human characteristics. The fœtus presenting a rudimentary tail, rudi-

[1] John A. Bergström, "Experiments upon Physiological Memory by Means of the Interference of Association." *Am. Jour. of Psychology*, Vol. V, p. 356 ff.

[2] For fuller account of these rudimentary organs consult Wiederscheim, The Structure of Man; Ernst Haeckel, Anthropogenie; Paul Topinard, Eléments d'Anthropologie Générale.

mentary cervical and lumbar ribs and many other traces of distinctly lower types. Even at the fifth month it is covered with a coat of hair similar to the simian species. The incredible persistence of these ancestral tendencies can be seen when one recalls, for instance, that the process of elimination of the cervical and lumbar ribs began as low in the scale of development as the reptiles and fishes, a time too remote to be accurately estimated in years.

On the psychic side, the simple mental life of animals presents many interesting cases of remote inheritance of once useful but now useless traits, such as the enmity between cats and dogs (little kittens "spit" at the odor of a dog even before their eyes open)[1]; the new born calf's fear of dogs; the habit of horses and dogs of turning around several times before lying down, even when on a smooth floor; the lapsing of many domesticated animals into a state of feral fierceness while eating, or during periods of sexual excitement; the covering of excreta by various animals, once probably a necessary means of protection against pursuit; the pawing of horses for food, probably inherited from the time when their ancestors had to paw away leaves or snow to find food; the return of the eels from the rivers to their old home in the sea when they are about to breed, and the similar return of salmon from the sea to their original river home during spawning season; the general tendency of both domesticated animals and of man to lapse to the wild condition when away from civilization. In adult man vagrant, predatory, and many other primitive instincts assert themselves continually even under the restrictions of civilization. It is in childhood, however, that the forces of heredity naturally assert themselves most strongly and present the animal and savage appetites and ideas common to children. Hall's work on the "Contents of Children's Minds," many of Barnes' papers mentioned previously, the work of Ellis and Hall on dolls, Sully's studies, Compayre's and Lombroso's books, and more recently Dawson's work on "Youthful Degeneracy," Burk's on "Teasing and Bullying" and specially Hall's work on fears,[2] show that the child's early psychic life is so filled with these rudimentary and revertionary types of activity that no theory save distant heredity can explain their presence. Whether this theory explains all these phenomena satisfactorily or not it is beyond the limits of this paper to discuss. This much appears certain; there are these rudimentary organs brought down in the body through incredible ages and there is

[1] Wesley Mills. Proc. and Trans. of the Roy. Soc. of Canada. Meeting of May, 1895, Sec. IV, p. 192.

[2] G. Stanley Hall, "A Study of Fears." *Am. Jour. Psychology*, VIII, 2.

no reason for denying to psychic characteristics a similar capacity for transmission, while, if we do not do this, the barbarous hectoring and bullying of children, their unnatural appetites and their senseless fears of feathers, insects, fur, etc., cannot be explained at all. That these rudimentary psychic organs, along with the rudimentary physical ones, are present can now hardly be denied. The questions for us as teachers are: first, what are the characteristics of the rudimentary activities; and second, how are they to be treated? The theologians and the school-men have said emphatically, "crush them upon first sight"— prune, lop off, trim down to adult standard has been the cry. But nature gives no evidence of dealing in this way with the body, and biology demands by what right we shall prune the soul. All improvement and growth in complexity of the body has been attained in evolution without the violent lopping off of a single cell. There the primitive organ was always transformed in form or function by slow growth, or was reabsorbed by the body and thus furnished an impetus to the new organ. The great and delicate organ of speech, the tongue, is simply a transformation and development of what was originally an organ of alimentation, the mammary glands are transformed sebacious glands; the primitive *stratum corneum* is transformed into the shell of the terrapin, the scales of the fish, and later into the hair, nails and hoofs of the higher vertebrate, and finally into the hair and nails of man — passing during the growth of the human embryo of the present day through modified forms of these stages. Prehensile organs, such as the hands in man and mandibles for mastication in the orthopods are transformed organs of locomotion. On the other hand, the legs of the frog are dependent, first, upon the development and then the reabsorption of the tadpole's tail, — any injury to the development of the rudimentary tail delays or weakens the future legs or kills the animal. Biology furnishes numbers of these cases, showing the dependence of the adult form upon the proper development, and transformation or absorption of the earlier rudimentary forms.

In looking at the psychic development of man something similar is seen; the primitive sex instincts and psychoses have been partly transformed and given rise to the domestic and family relations, to gallantry, and often altruism; the savage fright and terror developed gradually into reasonable caution, modesty, awe, reverence; the violent anger of children at people develops later into moral indignation at injustice—and so it is with other forms.

In the light of these biological facts and of the present evidence in child-study it must soon be recognized that this lopping off process in education is robbery and murder—tearing

away the natural raw material of the soul which it is the educator's duty to transform, or to give these rudimentary psychic organs such a development that they will reach maturity in early years, be absorbed and give their strength to later and nobler growths. In this light of biology and child study, education is seen to contain far more delicate and intricate problems than adult psychology and past philosophers of education have any means for handling, and hence the great and only hope for advance in pedagogy lies, in the future, in the working out of these new lines lately so vigorously opened up. One can rest satisfied with any present system only by remaining ignorant of the results of the work of the last few years.

Biology has certainly one suggestion, and that is that these rudimentary forms must be well fed. Marshall[1] says that a plentiful supply of food yolk tends to hasten the embryo through the recapitulatory forms, or may even cause it to skip some; while the lack of food for the full development of even a rudimentary stage may fix the embryo forever in the rudimentary condition, as students of teratology maintain, and as the study of tadpoles would indicate.

Bring School Work more in Line with the other Unavoidable Educational Influences of Life. Another reform in education is sorely needed and progress along this line may soon be expected, that is in bringing the efforts of the school more into line with the other natural and unavoidable educational influences, such as heredity and the struggle for existence in daily life. When one recalls that such a student of instinct as Romanes grades the various instincts of the highest animals as high as twenty-three on a scale upon which normal man reaches only fifty, it can be seen what a broad and far-reaching heredity we have before considering the human race. The development of these instincts and of their human, later evolved offshoots, offers certainly the natural and easy path for education and should be the first work of the teacher. We should certainly go into co-partnership with nature when it can furnish half of our needed material already practically prepared.

As the engineer in laying his roads through the mountains always seeks out and follows the course of the streams, taking advantage of the well worn paths made by the flow of nature's forces along these lines for untold years, so must the educator seek out and utilize those neural or psychic paths along which there is an easier progress because of the hereditary imprint left by the passage of the forces of life this way through countless generations.

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[1] Marshall. Biological Lectures and Addresses, 1894. Lecture XIII.

To bring together the best of the material now furnished upon the instincts and the training of animals by such careful workers as Darwin, Romanes, Wallace, Morgan, Mills, and others, and sift out the facts and principles shedding light or bearing upon human capacities and education is a work soon to be begun that will mark a new epoch in pedagogy. From this the kindergarten and early instruction should gain new life; for until the storm of adolescence begins to subside the instinct feelings bid fair to be proven by far the strongest factor in education.

In all probability this study of instinct will throw light upon the method of teaching by suggestion and hint, as opposed to such methodical hammering in as the "formal steps" and the usual Normal School pedagogy generally lead to. All of us, who ever really think at all, can remember instances in which a single question, an apt simile or a vague hint or hope, expressed perhaps in a public speech by some one, seized hold of our mind, set hundreds of new associations going, recurred ever and again as the days went by, each new fact giving it larger meaning till perhaps a whole new area was added to our mental life, gathered together by that one suggestion. Certainly these suggestions take hold, and will give no rest till followed out, only because they find material ready to receive them in the mind; and the possibility of their larger use in education rests upon a better knowledge of these dominant and moving mental appetites at different periods of life. If all the apperceptive material has to be consciously dragged up by the teacher and the interest awakened entirely by his efforts, that activity of suggestion which surmounts almost any obstacle and that mental hunger which devours any material give place to satiety and fatigue from dead effort of method. In the figure of Richter, to get the clearest note the hammer must just touch but never rest against the bell. Certainly no teacher or pupil could keep up this mode of teaching for five hours a day and in all the present school studies, but if a little more of it were used the five hours might be considerably reduced and part of the present wilderness of studies omitted.

The school work must also get into closer touch with the daily life of the child in the home, in the paths of business and upon the playground.

Play. The educational value of play has been much studied since Froebel's day, especially by the Italians.[1] The anthropologists have turned over to pedagogy large collections of the

[1] The best book is that of G. A. Colozza, "L Giuoco Nella Psicologia e Nella Pedagogia;" pp. 1–93, Il Giuoco Nella Psicologia; pp. 93–159, Il Giuoco Nella Storia Della Pedagogia; pp. 159–283, Il Giuoco Nella Pedagogia.

great folk-games of many of the races,[1] furnishing an invaluable basis for the systematization of such a curriculum of educational games and songs, that are really of interest to children, as will relieve much of the burden of education and reach many children in whom the present school work fails to awaken any response. Johnson[2] has made a valuable start in this direction, and has since shown by practical application at Andover that many of the mental qualities acquired by book study can be better acquired in plays and games, and that this stimulus may lead on to a new interest and success in the usual school work, as well as form a valuable aid to discipline.

In like manner, efforts are being made to carry further another of Froebel's suggestions and make the learning of various trades and occupations an educational influence and a connection between daily practical life and the school. Not the kind of work done in manual, trade, and technical schools, in which facility is the end aimed at and is acquired by continued repetition; but to teach one or more trades, not to give facility in work or even to make the trade of use, but to teach it only so far as it educates the mind or the muscles, changing to something else as soon as this point is reached and before sufficient practice is given to attain the great facility required in daily work. A study is needed of the various trades to find those of most educational value and that can be most easily adapted to school work.

Relation of the School and the Home. Every wise teacher looks with grave concern upon the widening gap between the school and the home. Parents are too willingly throwing the education and training of their children upon the hands of the State and the teachers. It is possible that under the peculiar circumstances of the time no other means could have accomplished so much; but a longer continuance of present conditions

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[1] Among the many valuable books, those most available are perhaps: Wm. Wells Newell, "Games and Songs of American Children;" New York, 1884. (This contains a valuable bibliography of foreign works. For later papers and books consult Johnson's Article in PED. SEM., III, 1.) Children's Singing Games with the Tunes to which They are Sung. Collected and edited by Alice B. Gomme. The Traditional Games of England, Scotland and Ireland, with Tunes, Singing Rhymes and Methods of Playing. Collected and Annotated by Alice Bertha Gomme. 2 vols. London, 1894. Since writing the above, Supt. Johnson's excellent article has appeared in the July, '97, North Western Monthly, giving a brief sketch of the development of play in pedagogy, and furnishing lists of games and a short working bibliography of the subject.

[2] G. E. Johnson, PED. SEM., III, 1. For an account of Supt. Johnson's "Play School" I am indebted to Dr. Hall. A brief account is also given by Herman T. Lukens, "Child Study for Superintendents." Ed. Rev. (N. Y.), Feb., 1897.

will inevitably lead to a wider breach. The formative influence upon character which the Herbartians claim for the orderly development of the mind through the school studies is granted, but it is the home life and training which furnish that basis of character without which the school is helpless. Nothing can take the place of the home, as Aristotle long ago saw, no one can relieve the parental responsibility. Civilizations have ever risen or fallen with the health, strength and purity, or disease and disintegration of home life. If our present school system must continue to disintegrate the home life, it will be a curse to mankind.

Some attempts are being made to unite these forces by a sort of "university extension," and lecture work with parents in the village High Schools, making these schools a center of culture and social influence among parents, students, and teachers alike. Dörpfeldt's plan of the "Freie Schulgemeinde,"[1] using the family as a basis of school organization and making it to participate more both in the local management and responsibilities of the school, has many suggestions for the American leaders. To solve the problem of the proper relation of the home and the school is utterly beyond the capacity of the present writer, but nothing is more apparent than the fact that pedagogy must soon handle this question far more earnestly and seriously.[2]

The Correlation of Myth and Science. The larger correlation in teaching of the mythopic and instinctive with the scientific and intellectual views of nature, is now demanding attention from a new standpoint, because of the better knowledge of child nature and the strong belief in the existence of what I have

[1] Dörpfeldt. "Schulgemeinde;" also see the "Fundamentstuck."

[2] Since writing the above my attention has been attracted by the efforts made to solve the above problem in Brookline, Mass., and the happy results of these. The work began in inviting the co-operation of the mothers with the primary teachers in the training of the younger children. The teachers and parents hold regular social meetings and discussions, at which each gets valuable information from the other, and parent and teacher form plans for mutual helpfulness in furthering the interests of each child. This work has spread upward in the schools to very great advantage. The Springfield High School is now following and improving part of the Brookline plan. Dr. Atkinson has very carefully prepared a list of questions asking for needed information from parents with regard to the health, appetite, hours for meals and sleep and study, tastes, reading habits, peculiarities or special capacities or deficiencies, likes, dislikes, interests, etc., etc., of each child. These reports are to be filed away together with similar reports from the grammar school masters, and are to be used in getting a better understanding of each student, so that he may be given a more just and rational treatment. These plans, only parts of which are here hinted at, are in the right direction and well deserve further investigation by every teacher.

termed merely a "food relation" between the culture material of one period of life and the mental states of higher stages. The large returns in knowledge and increased interest in nature, expected from the introduction of juvenile science into the grade schools, have failed to be realized. On every hand the report of the higher teachers is that the little smattering of science has not only failed to give children the accurate knowledge desired, but has often seared off the budding interest beyond possibility of revival in the serious later science work. This is a sore disappointment to pedagogy, in a direction where only hope seemed possible a few years ago. It is another illustration of the danger of applying the adult standard to children and of building *a priori* educational ideals, instead of first examining into the mental condition of the child to see what he wants and what he can handle. If we had known ten years ago what is now known of children, it could have been seen beforehand that they have little or no interest or apperceptive organ for scientific theories till well on into adolescence, that their reason, interest in original sources and scientific accuracy, power of making large inference, and critical judgment, eagerness to question and solve doubts of this kind do not rise till late, while the early school years are filled with an animistic appreciation of nature, with intense love of the usual mythopoeic and folk-conceptions. It is out of these conceptions in the race and not from the lack of them that science and philosophy have developed. A broad and deep background of myth has preceded and underlain every great national philosophy. The race unable to develop this myth in youth has failed to develop the philosophy and science in adult life. The question is then asked in all seriousness, if the later healthy growth of scientific interest is not starved in its embryonic period when the child is started with the strong food of pure science and not fed first upon the pap of nature myth and folk lore. Certain it is that studies of children show them, in spite of our efforts, often saturated with these notions and ever in sympathy with them. These myths represent the highest responses of the noblest minds of primitive ages to the forces of nature, and that they should awaken responsive chords in the child is but natural; and, however hard it is for us adults to see how these false notions open the heart and interest and lead the way later to opposite scientific views, there is every reason to believe this to be true. A propaideutic course in nature myth and folk-tale, and a proper correlation of this with the later scientific teaching suited to adolescence and manhood is what may be expected of future pedagogy. There are, to be sure, many problems both in kinds of myths to be selected and the exact method of teaching them.

President Hall is now engaged in a practical effort to make

at least a provisional correlation of these two views of teaching, and education has much to hope for in the near future from this effort. The great difficulty is, of course, in making the connection at the transition period of life between these opposing views. Mr. Henry R. Baker, and I believe also Dr. Hall, think it possible to bring these two views along in life together, making it a matter of varying emphasis — in childhood, much stress upon the myth side and very little on the scientific; in adolescence, shade gradually over to the opposite emphasis. By this means it is hoped to let the childish unity and sympathy with nature, expressed by the myth, pass over without break into the later philosophic, monistic unity. Whether this riding two horses at the same time, going in opposite directions, or this keeping two registers open in the soul, is possible or desirable the writer gravely doubts. That the mythopoeic view is the natural and the healthy one for little children seems quite certain, if a full soul and broad sympathy are to be developed; but it seems impossible, if even desirable, for this to modulate over to the scientific view without the doubt, upheaval, swing to the other extreme, oscillation, the *via dolorosa*, and reconstruction at adolesence. Upon this subject a better study of adolescence will doubtless throw light.

Religious Training. Closely connected with the problem of the relation between the school and the home, and the relation of the mythopoeic and scientific views of nature is the question of religious training. The provisional arrangement, growing out of the abuses of religion and the other necessities of the time, by which religious training has been divorced from the schools and considered beyond the pale of pedagogical science, must soon give place to the inevitable demand of nature. However useful such a separation has been in bridging over periods of retrogression and bigotry in both religion and pedagogy, to permanently keep religious and secular education separated is doing violence to our souls and trying to tear apart what is by nature one. The old faculty psychology is gone, a brighter era of religious toleration seems near, and now pedagogy must accept and own her whole field and face its problem of religious education squarely. To yield it longer to the theologians or to Special Providence is a criminal shirking of duty.[1] The

[1] Nowhere else in the history of text-book making was there ever such an opportunity as is now offered to the International Sunday School Lesson Committee. With a guarantee that their books will be used by over twelve millions of students, and that each committee's work will cover at least seven years, the possibilities of good or evil are incalculable, and yet there is not a man on the committee of great reputation as a pedagogue or psychologist. This is not intended to reflect upon the ability of the eminent theologians who prepare these lessons, or to suggest that a committee should be appointed composed

writer made two years ago a laborious, but little availing, attempt to begin a systematic study of Sunday School work, and to apply to it the methods of scientific pedagogy.[1] Dr. Hervey,[2] President Hall, and perhaps others have recently done work along the same line. But to improve the work of Sunday Schools will not suffice. When one considers that the dominant influence in the life of every race has been its religion, that religion has for thousands of years among all races been the very center and goal of all education, that, in fact, education itself is primarily a product and development of primitive religious regimen and ceremonies—the first special education of the race being wholly religious training, and everywhere the school-master evolving from the medicine-man or priest—and that now, even in spite of neglect, religion is yet the central influence in all great lives—when these facts are recognized, it seems necessary that religious training again be replaced as a dominant factor in education. The world needs the heart and feeling, the enthusiasm and hope that religion alone can give. In bringing this back into the schools, many and grave problems arise. The miserable failure of the so-called "undenominational" religious training attempted in the English Board schools[3] offers little hope of success to those efforts to eliminate from the Bible and religious instruction till no particle is left that is objectionable to any sect. The meagre fragments left of the corpse appear to please nobody and to be of little value to the children. The German plan of having selected ministers to call at specified times and instruct the pupils of their own denominations seems to work far better; but under any plan the grave questions of training the religious teachers, and of what and how to teach at the various periods of child growth are still to be solved by pedagogy. Studies of the religious development, though as yet only preliminary, indicate, as mentioned before, that under any sort of instruction children pass through widely differing phases of religious appreciation and development, which appear to demand a

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entirely of pedagogues and psychologists; but I do think that to prepare so gigantic an educational scheme without the earnest and continued co-operation of leaders in education is ridiculous—or would be were it not so pathetic, if not criminal.

[1] A. Caswell Ellis. "The Sunday School Work and Bible Study in the Light of Modern Pedagogy." PED. SEM., III, 3.

[2] Walter E. Hervey. "The Sunday Schools," The Review of Reviews, Dec., 1896.

[3] For a brief account of this trouble see Rep. Bu. of Ed. (U. S. A.), 1893-4, pp. 208—17: also the Educational Journals of England for the last few years; specially the Nineteenth Century, Nov. 1893, "Religion—at the London School Board;" and Dec. 1893, "The London School Board—a reply to Hon. Lyulph Stanly."

different kind of culture material and method of teaching. The full discussion cannot be entered here, but it suffices tosay that in religion as in nature-study the process of growth must be better recognized. The mythopoeic and anthropomorphic conceptions in each field are those most intelligible to small children, arousing as nothing else does the interest and sympathies, and warming the heart, out of which, after all, come the issues of life. The same problem of the awakening and the change at adolescence is present here, as in the study of nature, though fraught with more serious consequences. It can hardly be doubted longer that the proper training in religion for young children is not a reduced juvenile form of the higher spiritual and philosophic religious conceptions of cultivated adults, for these are shown generally to awaken an utterly false response or none at all; but that young children should have the religious truths presented to them in the mythopoeic and anthropomorphic forms, which may undergo new interpretations in the child's soul as his growing natural capacity makes possible the rise from lower to higher conceptions of Deity and Divine laws. There are still the questions of what manner of teaching and of what myths have greatest forming power over the child's soul and at the same time prepare the way for the later growth, neither permanently moulding the soul to its primitive form nor throwing it into agnosticism when larger contradictory conceptions are reached.

As grave as are the problems presented by this method of teaching, they must be met; for educators to longer hold aloof or to refuse absolutely in the name of truth and science to teach young children thus, is to show no appreciation of the laws of nature's growth as seen everywhere, and to starve young religious natures. Children are shown the physical universe and allowed to believe what they are able, though we know they will see contours as flat shades and will have no appreciation of the principles of idealistic philosophy. Children, like men, can grow only by using the powers they already have, bumping their heads and learning better. Unless education prove recreant to her duty, the whole question of religious training will be soon rehandled boldly, though reverently, and some order brought out of the present chaos of superstition and sentimentalism on the one hand and on the other a hardly less serious ignorance and bigotry under the name of truth and science. Religion will soon be given its larger and truer scope. In the schools it will be recognized that religious training is interwoven with every study, not as the school men used to make mathematics teach the Trinity, but that every new truth has its religious bearings, if so taught as to warm our sympathy for nature and our love of God and man and develop a deeper

appreciation of the marvellous perfection of Divine laws and the true dignity and duties of life.

Specialization, both in studying and teaching, is forging to the front in recent years. Specialization in studies on the part of college students is already generally recognized as necessary for the best mental development. Aside from the fact that the enormous growth of all sciences now makes it impossible for one to get even a smattering of them all, if he should try, it is seen that nothing so makes for good mental habits, clear thought and sound scholarship as for a student to investigate one subject thoroughly from all sides till he is a master in this small field. Nothing else inspires and gives the student a healthy self-respect so much as to feel that on this point, however small, "he is an authority and not an echo." Since the introduction of the comparative method in all branches of study, practical experience shows that almost any specialty, if pursued to its natural and proper extent, will lead the student to a broad, general culture that is better mastered, can be better handled, and is of more real mental value to its possessor than the disconnected, superficial knowledge of the many subjects supposed to be necessary for general culture. This specialization is, of course, the necessary outcome of the movement in education demanding that a child be allowed to follow those lines of effort for which he is by nature best fitted. Interests of children are so fluctuating, their power of concentration for any long-continued, serious effort so small until after puberty, that it seems that specialization should not be attempted before that time; but during adolescence, when the interests, the likes and dislikes, the enthusiasms and energies are very intense for periods of moderate length, it seems that specialization along lines of strong interest should, by all means, be allowed in the high schools, and possibly in the last grammar grades, in order that those adolescent energies be not wasted or turned into morbid channels, and that the habit be fostered in the youth of doing serious, intense work in the pursuit of what appears to him to be a worthy problem. This will not at this age continue long on any one subject, and will not at all exclude general culture—indeed, rightly followed, the normal interests of a healthy boy would soon cover, perhaps, a larger and better field than do our present *curricula*.

Specialization on the part of teachers is becoming far more common, though serious objections to it arise. We now have separate teachers for music, drawing and penmanship, generally for physical and manual training, and occasionally for science, nature study, or modern languages. The introduction of these specialists seems on the whole to have resulted advantageously. How far this can be done successfully only experience will tell,

but whatever is claimed for specialization on the part of students applies to teachers, and whatever may be lost, and much certainly is, from the necessary lack of continued intimate contact with the pupils and knowledge of them by these teachers, seems more than balanced by their superior knowledge and enthusiasm, which can be possessed only by a specialist.

Physical Education. Among the numerous advances in education none strike deeper and are more potent for good than the practical recognition again that upon the cultivation of a sound body rests ultimately the whole superstructure of education. The works in pathology, criminology, physiology and neurology, specially in the study of the effects of fatigue and of various stimulants and foods upon brain cells and mental and physical activity, already offer to pedagogy many valuable suggestions and command numerous changes in school programmes. The limits of this sketch compel me to refer to the originals for these facts in detail.[1]

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[1] The few books and articles referred to here are, of course, a small fraction of the number that might be given, but such works are selected as represent the best in their respective fields and yet are simple enough to be of use to the average intelligent teacher.

J. S. Clouston. Clinical Lectures on Mental Diseases.

Emil Kraepelin. *Lehrbuch der Psychiatrie*, 5th ed.

Havelock Ellis. The Criminal.

Wm. Ferri. Criminal Sociology.

H. H. Donaldson. The Growth of the Brain.

J. Ryland Whitaker. Anatomy of the Brain and Spinal Chord.

Ramon y Cajal. "*La Fine Structure des Centres Nerveux.*" Proced. Royal Soc., Vol. 55.

C. F. Hodge. "A Microscopical Study of Changes due to Functional Activity in Nerve Cells." (Boston, 1892.) Journal of Morphology, Vol. VII, No. 2.

Burgerstein. "*Die Arbeitskurve einer Stunde.*" *Zeitschrift fur Schulgesundheitspflege, Band IV, Heft. 9, 10.*

H. Emminghaus. "*Die Psychischen Störungen in Kindes-Alter:*" Gerhard's *Handbuch der Nervenkrankheiten, Nachtrag* II. Tübengen, 1887.

Keller, "*Pädagogische psychometrische Studien.*" *Biologisher Centralblatt.* 1894. Nos. 1, 2, 9.

A. Maggiora. "*Ueber die Gesetze der Ermudüng. Untersuchungen an Muskeln des Menchen.*" *Archiv. f. Phys.* (Du Bois Reymond), *Drittes und Viertes Heft*, 1890.

Mosso. *Die Ermüdung. Leipsic*, 1892.

Henry J. Berkley. "Alcoholic Poisoning." J. Hop. Hospital Rep., Vol. VI, No. 1.

C. C. Stewart. "Effect of Acute Alcoholic Poisoning on Nerve Cells." Jn. Ex. Med., Vol. I, No. 4.

Emil Kraepelin. *Ueber die Beeinflussing einfacher psychischer Vorgange durch einige Artzneimittel.*

August Smith. *Die Alkoholfrage und ihre Bedeutung fur Volkswohl und Volksgesundheit.*

C. F. Hodge. "Effect of Alcohol on Animal Activity." Pop. Sci. Mo., Mar. and Apr., 1897.

It was a revolution when the monkish attempt to develop the soul by destroying the body gave place to the saner modern views; but this movement has been hampered seriously by the lack of educated leaders. Until very recently the director of physical education has generally been little more than a splendid physical animal leading in various lines of physical prowess and possessing a repertoire of empirically devised exercises and linements, courses of diet and bathing and rubbing that made muscular giants, in some particular line of those already possessing a physical stamina that could stand almost any hardship, but leaving the weak to look out for themselves or shattering their feeble frame under the strain of the heroic and unphysiological treatment. In fact, this order of things is not yet passed. Many of the leaders in physical culture are still little more than lackeys to lead exercises and to time and rub down athletes, possessing merely a smattering of anatomy and physiology and little acquaintance with the facts of neurology or the alimentary and culinary chemistry. The few educated leaders in this work know very well that such sights as four mile boat races with several collapsed hearts at the finish do not mean physical culture. It may be true that it is better to kill off a few men by over exertion, than to kill adolescent interest in athletics and return to the old monkish order by stopping all sports that are dangerous; but time is fast approaching when this is to be seen in its true light and the efforts of leaders of physical culture are to be directed towards more accurate experiments on the effect of different articles of diet at various ages and seasons of the year and under varying mental and physical tasks; the effect of long and short periods of sleep and the proper periods and alternations of different kinds of work, and of rest and work at different times of life. The present ignorance on these fundamental facts, which are open to direct experiment, is discouraging. A very little has been done at Chicago and Wesleyan and Clark on the subject of foods, but the writer has found absolutely nothing of value in English, and little more in German on the subject of how to rest and recuperate. Nothing is more demanded now than a thorough study of various methods of rest and recuperation; for upon capacity to rest depends capacity to work. The experiments of Mosso, Keller, Emminghaus and others show the

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Heirnich Dehio. "*Experimentelle Untersuchungen ueber die Veranderungen der Ganglienzellen bei der acuten Alkoholvergiftung. Centbl. f. Nervenkh. und Psych. Marz-Heft.* 1895.

W. O. Atwater. "How Food is Used in the Body." Century, June, 1897. "Preliminary Report of Investigations on Metabolism by Man." Published by the Office of Experiment Stations of the United States Department of Agriculture.

rapid wear of the mental and physical organism in all kinds of work, and indicate the great advantage of short periods of work at high pressure alternating with short periods of rest; but just what gives the greatest rest is as yet a subject of dispute. This much does seem certain, that intricate calisthenics and exercises demanding strong attention, or great physical exertion do not properly rest a brain tired from study. The need for a long period of continuous sleep, especially long in youth, is impressed ever more firmly; but in what way to spend waking periods in order to best rest and recuperate for renewed efforts is still entirely unsettled ground. The matter of temperament and individual peculiarities will, of course, ever complicate the problem.

The larger views of physical training, the relation of the muscles as organs of the will to character, and the relation of bodily to emotional states are yet to receive adequate treatment.

Upon the practical side, it may all be summed up by saying that the stress of physical training will gradually shift from the present undue effort to cultivate strong muscles to an attempt primarily to preserve and foster a strong heart and lungs, nerves, liver, kidneys, stomach, etc. True it is that one of the chief means of developing these vital organs is found in the muscles, yet many of the present forms of exercise which develop muscle endanger or actually injure the vital organs. These must give place to saner measures of exercise, to well placed periods of rest, properly selected diet and clothing, and hygienically constructed dwellings, which are far more potent for physical and mental sanity than anything else in education.

In Conclusion. After surveying the tortuous progress of past centuries in educational ideals and methods, and looking at the intense activity of recent years and the uparalleled advance of knowledge in all of the sciences upon which pedagogy is based, one can but consider the present division among leaders of education as the prelude to the falling of many cherished idols to make way for a new philosophy built upon a larger and better knowledge of nature and of man. Every year is adding new facts to the store; new phases of human life and human needs and possibilities are seen now as never before, and make only the more apparent the present ignorance and the insufficiency of the present systems. *Children must be studied.* With this new center for our educational universe, there must be confusion till more points are fixed and laws of movement known, but with the increase of investigation the new century will furnish data from which the synthetic mind of a Copernicus or a Kant can give such an account of the laws and growth of the human soul as is now little dreamed of in our philosophies.

EYE DEFECTS IN STUDENTS AND CHILDREN.

By Edgar James Swift, Psychology and Pedagogy, State Normal School—Stevens Point, Wis.

The investigation, the results of which the present paper discusses, was undertaken for the purpose of finding out the condition of the eyes of young people engaged in study.

The tests were made by Dr. D. N. Alcorn, the able oculist of Stevens Point.

The writer is also greatly indebted to Dr. Alcorn for valuable suggestions in the preparation of this paper. Without his generous co-operation the investigation would have been impossible.

The tests were (1) the ordinary tests of each eye for vision, the sight of the other eye being shut off by an opaque disk; (2) the card test for astigmatism; (3) the Maddox multiple rod test for muscle trouble and (4) the diagnosing of errors of refraction by means of the ophthalmoscope. The one undergoing an examination sat twenty feet from the test chart. The type used in the chart was Hermann Snellen's, but as the type used in Snellen's charts is not always of the same size, owing to the carelessness of those who print them, I will give the measurements of the letters used in this examination.

The type which a normal eye should read at a distance of twenty feet was nine millimeters square. This represents normal vision and is designated in this paper by twenty twentieths. The twenty thirtieths type was thirteen millimeters square, the twenty fortieths eighteen millimeters, twenty sixtieths twenty-six millimeters, twenty eightieths thirty-five millimeters, twenty one hundred twentieths fifty-two, and twenty two hundreths eighty-seven millimeters square.

Over three hundred and forty were examined and all the tests were made in each case.

As those examined were of widely different ages, being pupils in the various grades of the model school as well as in the normal, I have preserved the natural divisions into which they fall, *i. e.*, normal students, grammar grade pupils and intermediates with the primary.

As the more defective eye rather than the better of the two gauges the eye strain, it seemed best to group the subjects on the basis of the less efficient eye.

Group I gives those students of the normal department whose

vision in both eyes was normal or better, *i. e.*, represented by $\frac{20}{20}$ or $\frac{20}{20}+$.

Group I.

Neither eye defective in vision.

No. 1, age 20, latent astigmatism (slight).
No. 2, age 23, no evident defect.
No. 3, age 16, latent hyperopia — astigmatism — hyperphoria 1¾°.
No. 4, age 20, astigmatism—exophoria.
No. 5, age 25, hyperopia—astigmatism.
No. 6, age 18, astigmatism.
No. 7, age 16, hyperopia—esophoria 3°—left, hyperphoria 2°.
No. 8, age 22, no evident defect.
No. 9, age 20, latent hyperopic astigmatism compound.
No. 10, age 17, latent hyperopic astigmatism compound.
No. 11, age 19, hyperopia.
No. 12, age 16, hyperopia—esophoria 4°—left, hyperphoria.
No. 13, age 19, esophoria ½°—ciliary paresis.
No. 14, age 23, latent hyperopic astigmatism.
No. 15, age 31, mixed astigmatism—muscle trouble.
No. 16, age 22, hyperopic astigmatism—esophoria 3°.
No. 17, age 21, blepharitis.
No. 18, age 20, hyperopic astigmatism—exophoria 1°.
No. 19, age 22, esophoria 8°.
No. 20, age 19, hyperopic astigmatism.
No. 21, age 15, hyperopic astigmatism—esophoria 2°.
No. 22, age 21, latent hyperopia.
No. 23, age 23, hyperopic astigmatism—esophoria 2°.
No. 24, age 16, hyperopia.
No. 25, age 20, mixed astigmatism.
No. 26, age 17, hyperopia—esophoria 2°.
No. 27, age 17, no evident defect.
No. 28, age 16, concomitant divergent strabismus—exophoria 6°—left, hyperphoria ½°.
No. 29, age 19, hyperopia—ciliary spasms.
No. 30, age 18, hyperopia.
No. 31, age 15, latent hyperopia—exophoria 3°.
No. 32, age 14, hyperopic astigmatism compound—right, hyperphoria ½°
No. 33, age 14, hyperopic astigmatism—esophoria 3°.
No. 34, age 19, esophoria 1°.
No. 35, age 21, right eye, hyperopic, left hyperopic astigmatism.
No. 36, age 22, right eye, hyperopic, left, hyperopic astigmatism—esophoria 1°.
No. 37, age 17, latent hyperopia.

Group II.

Including those normal students whose vision in the more defective eye is $\frac{20}{30}$ and better but not normal.

No. 1, age 17, astigmatism—esophoria 12°.
No. 2, age 23, hyperopia (slight).
No. 3, age 19, hyperopic astigmatism.
No. 4, age 35, esophoria 4°—left, hyperphoria ½°—astigmatism.
No. 5, age 19, myopic astigmatism.
No. 6, age 21, myopia.
No. 7, age 20, right eye, myopia astigmatism compound—esophoria 2°.
No. 8, age 20, astigmatism—esophoria 7°.
No. 9, age 21, myopic astigmatism compound—esophoria 1°.
No. 10, age 22, latent hyperopia.[1]
No. 11, age 23, right eye, myopic astigmatism—left, myopia.
No. 12, age 19, latent hyperopic astigmatism.
No. 13, age 25, hyperopia—esophoria 4°.
No. 14, age 17, latent hyperopia—esophoria3°.
No. 15, age 22, hyperopic astigmatism compound.
No. 16, age 18, mixed astigmatism.
No. 17, age 23, hyperopia—esophoria 3°.
No. 18, age 22, myopia.
No. 19, age 35, hyperopic astigmatism compound.
No. 20, age 22, myopic astigmatism.
No. 21, age 21, hyperopic astigmatism compound.
No. 22, age 20, mixed astigmatism—esophoria 1°.
No. 23, age 24, excessive esophoria.
No. 24, age 22, mixed astigmatism.
No. 25, age 20, left eye, hyperopic astigmatism—right eye, hyperopia.
No. 26, age 18, excessive esophoria—left eye, myopic astigmatism.
No. 27, age 16, latent hyperopia.
No. 28, age 27, mixed astigmatism.
No. 29, age 23, myopic astigmatism compound.
No. 30, age 22, hyperopia—left, hyperphoria½°.
No. 31, age 23, latent hyperopia.
No. 32, age 20, hyperopic astigmatism.
No. 33, age 27, hyperopic astigmatism.
No. 34, age 20, latent hyperopia.
No. 35, age 24, myopic astigmatism—exophoria 2°—left, hyperphoria ½°.

[1] We often have manifest myopia where latent hyperopia really exists.

No. 36, age 17, latent myopic astigmatism—esophoria 5°—right, hyperphoria ½°.
No. 37, age 16, hyperopia.
No. 38, age 19, myopic astigmatism—esophoria 2°.
No. 39, age 18, latent hyperopia—hyperphoria ½°.
No. 40, age 20, mixed astigmatism—esophoria.
No. 41, age 21, myopia.
No. 42, age 21, hyperopic astigmatism.
No. 43, age 18, hyperopic astigmatism compound.
No. 44, age 19, hyperopic astigmatism compound.
No. 45, age 17, exophoria 4°—hyperopia.
No. 46, age 22, right eye, hyperopic astigmatism—left, mixed astigmatism.
No. 47, age 20, esophoria 2°—mixed astigmatism.
No. 48, age 17, latent hyperopia.
No. 49, age 18, hyperopic astigmatism compound—left, hyperphoria ½°—esophoria 8°.
No. 50, age 19, hyperopic astigmatism compound—esophoria 1°.
No. 51, age 19, hyperopic astigmatism compound—esophoria, 1°.
No. 52, age 20, hyperopia—esophoria 3°.
No. 53, age 20, right eye, hyperopic astigmatism—left, myopic astigmatism—esophoria 2°.
No. 54 age 35, hyperopic astigmatism compound.
No. 55 age 25, hyperopic astigmatism compound—exophoria 1°.
No. 56, age 19, excessive myopic astigmatism—exophoria 1°.
No. 57, age 18, myopia—exophoria 1°.
No. 58, age 23, right eye, hyperopic astigmatism—left, myopic astigmatism—exophoria 2°.
No. 59, age 17, hyperopic astigmatism compound—esophoria 3°.
No. 60, age 21, hyperopic astigmatism—esophoria 1°.
No. 61, age 22, hyperopic astigmatism — esophoria 1°—left, hyperphoria ½°.
No. 62, age 20, hyperopic astigmatism.
No. 63, age 20, hyperopia.
No. 64, age 19, left, hyperphoria 2°.
No. 65, age 23, latent hyperopia.
No. 66, age 16, hyperopia—esophoria 2°.
No. 67, age 21, myopic astigmatism—left, hyperphoria ½°—esophoria 2°.
No. 68, age 19, myopic astigmatism—esophoria 1°.
No. 69, age 17, hyperopic astigmatism—exophoria 2°.
No. 70, age 41, irregular astigmation—myopic in one part and hyperopic in the other.
No. 71, age 40, hyperopic astigmatism.

No. 72, age 26, hyperopia—esophoria 2°.
No. 73, age 16, hyperopic astigmatism—esophoria 15°—right, hyperphoria 2°.
No. 74, age 22, hyperopia—esophoria 2°—left, hyperphoria 2°.
No. 75, age 17, asthenopia.
No. 76, age 22, mixed astigmatism—esophoria 1°.
No. 77, age 26, esophoria 4°—right eye, hyperopic—left, hyperopic astigmatism.
No. 78, age 30, hyperopic astigmatism—exophoria 3°.
No. 79, age 20, esophoria 1°—right eye, hyperopia—left, hyperopic astigmatism.
No. 80, age 19, hyperopia—esophoria 4°.
No. 81, age 20, hyperopic astigmatism.
No. 82, age 14, exophoria 1°—right eye, hyperopia—left, hyperopic astigmatism
No. 83, age 18, astigmatism.
No. 84, age 20, myopic astigmatism—exophoria 1°.
No. 85, age 23, hyperopic astigmatism compound—esophoria 1°.
No. 86, age 24, latent hyperopia.
No. 87, age 29, myopic astigmatism—esophoria 2°.
No, 88, age 18, hyperopic astigmatism—exophoria 5°—right, hyperphoria 1°.
No. 89, age 19, left eye, hyperopic astigmatism compound—right, hyperopic astigmatism.
No. 90, age 24, myopia—asthenopia.
No. 91, age 22, mixed astigmatism—esophoria 2°—right, hyperphoria ½°.
No. 92, age 17, hyperopic astigmatism—esophoria 1°.
No. 93, age 18, hyperopia.
No. 94, age 26, hyperopic astigmatism—esophoria 2°.
No. 95, age 19, myopia—esophoria 1°.
No. 96, age 22, hyperopic astigmatism—esophoria 2°.
No. 97, age 16, mixed astigmatism—esophoria 2°.
No. 98, age 16, hyperopic astigmatism—esophoria 1°.
No. 99, age 34. myopic astigmatism—esophoria 4°—right, hyperphoria 1°.
No. 100, age 15, mixed astigmatism—exophoria 2°.
No. 101, age 21, hyperopic astigmatism—esophoria 3°.
No. 102, age 19, myopia.
No. 103, age 21, hyperopic astigmatism compound—exophoria 1°.
No. 104, age 23, hyperopic astigmatism compound—esophoria 3°.
No. 105, age 22, hyperopic astigmatism compound—esophoria 1°.
No. 106, age 21, hyperopic astigmatism compound—oblique astigmatism.

No. 107, age 19, right eye, latent hyperopia—left eye, hyperopic astigmatism compound.
No. 108, age 23, hyperopic astigmatism compound—exophoria 1°—left, hyperphoria ½°.
No. 109, age 17, hyperopic astigmatism compound—concomitant divergent strabismus.
No 110, age 18, latent hyperopia—exophoria 1°.
No. 111, age 18, hyperopia—exophoria 1°—left, hyperphoria 1°.
No. 112, age 15, latent hyperopic astigmatism—exophoria 5°.
No. 113, age 19, hyperopic astigmatism compound.
No. 114, age 15, myopia—esophoria 2°.
No. 115, age 19, right eye, hyperopia—left, (slight) myopia.
No. 116, age 18, hyperopia—exophoria ½°.
No. 117, age 19, latent hyperopia—esophoria ½°.
No. 118, age 15, hyperopic astigmatism compound—esophoria 2°.
No. 119, age 19, hyperopic astigmatism—esophoria 2°.
No. 120, age 17, hyperopic astigmatism compound—esophoria 2°.
No. 121, age 17, right eye, myopia—left, hyperopia—esophoria 2°.
No. 122, age 18, mixed astigmatism—esophoria 2°.
No. 123, age 17, myopia—esophoria 1°.
No. 124, age 21, mixed astigmatism—esophoria ½°—hyperphoria (slight).
No. 125, age 20 hyperopic astigmatism—esophoria 5°.
No. 126, age 33, right eye, hyperopia—left, hyperopic astigmatism—right, hyperphoria ½°.
No. 127, age 24, hyperopia—esophoria 3°.
No. 128, age 25, hyperopia.
No. 129, age 19, hyperopia—exophoria 2°.
No. 130, age 16, hyperopic astigmatism compound—exophoria 1°—right, hyperphoria ½°.
No. 131, age 17, hyperopic astigmatism—esophoria 2°.
No. 132, age 18, right eye, hyperopic astigmatism compound—left, hyperopia—esophoria 2°.
No. 133, age 23, hyperopic astigmatism compound—exophoria.

Group III.

Including those normal students whose vision in the more defective eye was $\frac{20}{40}$ or better but not so good as $\frac{20}{30}$.

No. 1, age 35, myopic astigmatism—esophoria 4°—left, hyperphoria ½°.
No. 2, age 26, myopic astigmatism.
No. 3, age 20, right eye, myopic astigmatism compound—left, myopia—esophoria 2°.

No. 4, age 17, hyperopic astigmatism—esophoria.
No. 5, age 16, mixed astigmatism.
No. 6, age 16, mixed astigmatism exophoria 10°.
No. 7, age 23, mixed astigmatism exophoria 2°.
No. 8, age 26, hyperopic astigmatism compound—hyperphoria 3°.
No. 9, age 18, mixed astigmatism.
No. 10, age 25, right eye, myopic astigmatism—left, myopia.
No. 11, age 21, myopic astigmatism—right, hyperphoria ½°.
No. 12, age 18, right eye, hyperopic astigmatism—left, hyperopia—esophoria.
No. 13, age 18, hyperopic astigmatism.
No. 14, age 24, myopic astigmatism—esophoria 5°.
No. 15, age 25, myopic astigmatism—exophoria 11°.
No. 16, age 19, left, hyperphoria ½°.
No. 17, age 18, mixed astigmatism—esophoria.
No. 18, age 17, mixed astigmatism—esophoria 2°.
No. 19, age 29, hyperopic astigmatism compound.
No. 20, age 18, hyperopic astigmatism at an oblique angle—esophoria 3°.
No. 21, age 17, myopic astigmatism—exophoria 2°.
No. 22, age 17, hyperopic astigmatism—esophoria 2°.
No. 23, age 19, hyperopic astigmatism—esophoria 1°.
No. 24, age 24, hyperopic astigmatism—esophoria 1°.
No. 25, age 18, hyperopic astigmatism—esophoria 3°.
No. 26, age 16, hyperopia—esophoria 5°.
No. 27, age 20, hyperopic astigmatism—esophoria 1°.
No. 28, age 21, hyperopia—esophoria 2°—right, hyperphoria ½°.
No. 29, age 17, hyperopic astigmatism compound—esophoria 1°.
No. 30, age 18, hyperopic astigmatism—esophoria 2°—right, hyperphoria ½°.
No. 31, age 22, hyperopic astigmatism compound—esophoria 5°.

Group IV.

Including those normal students whose vision in the more defective eye was $\frac{20}{60}$ or better but not so good as $\frac{20}{40}$.

No. 1, age 24, hyperopic astigmatism compound—left, hyperphoria ½°.
No. 2, age 17, myopic astigmatism compound.
No. 3, age 22, latent hyperopia—exophoria 2°.
No. 4, age 25, myopic astigmatism.
No. 5, age 26, right eye, myopic astigmatism compound—left, myopic astigmatism.
No. 6, age 17, mixed astigmatism—exophoria 12°—oblique muscle trouble.

No. 7, age 36, myopic astigmatism.
No. 8, age 21, myopic astigmatism compound — convergent strabismus.
No. 9, age 22, right eye, myopic astigmatism compound — left, myopia.
No. 10, age 21, hyperopic astigmatism—exophoria 2°.
No. 11, age 21, mixed astigmatism—esophoria 3°.
No. 12, age 18, mixed astigmatism—exophoria 1°.
No. 13, age 32, mixed astigmatism—esophoria 1°.
No. 14, age 21, hyperopic astigmatism compound — esophoria 3°.
No. 15, age 23, hyperopic astigmatism compound — esophoria 3°—left, hyperphoria ½°.
No. 16, age 23, myopia—esophoria 2°.
No. 17, age 25, astigmatism.
No. 18, age 26, hyperopic astigmatism compound—convergent strabismus.
No. 19, age 18, myopic astigmatism—esophoria 1°.
No. 20, age 35, myopic astigmatism—right, hyperphoria 1°.

Group V.

Including those normal students whose vision in the more defective eye was $\frac{20}{80}$ or better but not so good as $\frac{20}{60}$.

No. 1, age 23, myopic astigmatism—exophoria 2°.
No. 2, age 23, mixed astigmatism—right, hyperphoria 2°.
No. 3, age 24, mixed astigmatism.
No. 4, age 25, mixed astigmatism—right eye, hyperopia—left, myopia.
No. 5, age 17, hyperopia—concomitant convergent strabismus.
No. 6, age 18, hyperopic astigmatism compound—esophoria 1°.
No. 7, age 20, myopic astigmatism—esophoria 2°.

Group VI.

Including those normal students whose vision in the more defective eye was $\frac{20}{120}$ or better but not so good as $\frac{20}{80}$.

No. 1, age 19, hyperopic astigmatism compound—esophoria 3°—left, hyperphoria ½°.
No. 2, age 16, hyperopic astigmatism—esophoria 1°.
No. 3, age 19, right eye, hyperopic astigmatism compound—left, hyperopic astigmatism—divergent strabismus.
No. 4, age 19, hyoperopic astigmatism compound.
No. 5, age 14, myopic astigmatism compound—esophoria 7°—left, hyperphoria ½°.
No. 6, age 20, right eye, hyperopic astigmatism—left, hyperopic astigmatism compound exophoria 5°.
No. 7, age 18, myopic astigmatism compound.

Group VII.

Including those normal students whose vision in the more defective eye was $\frac{20}{200}$ or better but not so good as $\frac{20}{120}$.

No. 1, age 25, exophoria 12°—right, hyperphoria 1°—amblyopia.
No. 2, age 19, hyperopic astigmatism—partial atrophy of left optic nerve.
No. 3, age 23, myopic astigmatism—concomitant divergent strabismus.
No. 4, age 20, myopic astigmatism compound.
No. 5, age 21, excessive mixed astigmatism.
No. 6, age 20, hyperopic astigmatism compound—esophoria 3°.
No. 7, age 21, myopic astigmatism compound.
No. 8, age 20, myopia.
No. 9, age 18, right eye, myopic astigmatism compound—left, mixed astigmatism—ciliary spasms.
No. 10, age 22, mixed astigmatism—left, hyperphoria 1°.
No. 11, age 26, hyperopic astigmatism compound—esophoria 2°.

Group VIII.

Including those normal students whose vision in the more defective eye was below $\frac{20}{200}$.[1]

No. 1, age 19, R. V. $\frac{3}{200}$ L.V. $\frac{3}{200}$ [2] myopic astigmatism compound—concomitant divergent strabismus.
No. 2, age 20, R. V. $\frac{8}{200}$ L. V. $\frac{3}{200}$, myopic astigmatism compound.
No. 3, age 20, R. V. $\frac{8}{200}$ L. V. $\frac{8}{200}$, myopic astigmatism compound.
No. 4, age 18, R. V. $\frac{8}{200}$ L. V. $\frac{20}{20}$, traumatic cataract—slight hyperopia.
No. 5, age 22, R. V. $\frac{20}{80}$ L. V. $\frac{3}{200}$, excessive hyperopia—amblyopia.
No. 6, age 23, R. V. $\frac{8}{200}$ L.V. $\frac{20}{80}$, hyperopic astigmatism compound.
No. 7, age 18, R. V. $\frac{8}{200}$ L. V. $\frac{8}{200}$, myopic astigmatism compound—esophoria 2°—left, hyperphoria ½°.
No. 8, age 23, R. V. $\frac{20}{40}$ L.V. $\frac{12}{200}$, hyperopic astigmatism compound.
No. 9, age 17, R. V. $\frac{3}{200}$ L. V. $\frac{4}{200}$, myopic astigmatism compound.
No. 10, age 20, R. V. $\frac{20}{200}$ L.V. $\frac{10}{200}$, myopia—exophoria 16°.
No. 11, age 20, R. V. $\frac{4}{200}$ L.V. $\frac{2}{200}$, myopia—exophoria 2°.

[1] As the vision of those below $\frac{20}{200}$ is too irregular to admit of classification the vision is given in each case.

[2] R. V. = vision of the right eye. L. V. = vision of the left eye. The numerator as before represents the distance from the chart in feet.

If we turn to Group I for a moment we find that out of two hundred and fifty-seven, the entire number of normal students students examined, only thirty-seven or fourteen and thirty-nine hundredths per cent. have the normal vision of twenty twentieths.

It is important to notice that of these thirty-seven students with normal vision five have astigmatism without hyperopia, ten hyperopia without astigmatism and fourteen have both defects, while nineteen have muscle trouble with or without other difficulties, and only three have no evident defects.

It should be noted that no mydriatic was used in the examinations, as would have been necessary had the fitting of glasses been the purpose. Without a mydriatic some defects fail to disclose themselves and the muscle trouble is almost always greater one way or the other than the tests show.

Passing to Group II, we find that one hundred and thirty-three students, that is, fifty-one and seventy-five hundredths per cent., have at least one eye whose vision is between twenty twentieths and twenty thirtieths. In other words, that they may recognize with this eye any letter in the alphabet at a distance of twenty feet, these letters must be thirteen millimeters square.

Thirty-one in this group have hyperopia, thirty-four astigmatism, and fifty-six have a combination of both in the simple or compound form. In addition, eighty-five have muscle trouble, usually in connection with hyperopia or astigmatism or both.

The number of cases of manifest muscle trouble found is remarkable. In Group I nineteen out of thirty-seven had this difficulty, and in Group II eighty-five out of one hundred and thirty-three. In each group more than fifty per cent. showed some form of this defect.

In each of the two groups more than fifty per cent. have astigmatism with or without hyperopia.

It may be, as one authority has said, that almost all children are hyperopic at birth, but why this large per cent. of astigmatism and muscle trouble? Are eyes defective in all these respects at birth, or is it rather due to the accompaniments of civilization by which night is turned into day and the strain which was once limited to the time of sunlight is now relieved only during sleep?[1] Or, again, is that which manifests itself in one disease or another the result of continued imperfect function, whose primary cause is to be found in the nerve centers, as Dr. Prentice thinks?

I am well aware that it is much easier to ask these questions

[1] We often have manifest myopia where latent hyperopia really exists.

than to answer them, but a clear recognition of the importance of any problem is the beginning of its solution.

As civilization advances the fund of necessary knowledge constantly increases, and in its acquisition the eyes are ever put to severer strain. It is possible that the imperfect work of nature will require earlier correction than has hitherto been thought wise; or it may be that our school arrangements of seating, lighting, school hours, etc., weaken the eyes more than the study necessitates. The question is certainly worth investigation.

If we combine groups V, VI, VII and VIII, that is, those whose vision in the more defective eye is below twenty sixtieths, we find that the new group thus formed contains thirty-six, or only one less than those whose vision in both eyes is normal or better.

In order that a comparison might be made between younger and older scholars in vision and eye defect, pupils from the grades were also examined.

Table IX contains those found in the seventh and eighth grades whose vision in both eyes was normal or better.

Group IX.

Including those seventh and eighth grade pupils whose vision in both eyes was normal or better, i. e., represented by $\frac{20}{20}$ or $\frac{20}{20}+$.

No. 1, age 14, right eye, hyperopic astigmatism—esophoria 2°.
No. 2, age 12, hyperopic astigmatism compound—esophoria 2°.
No. 3, age 15, hyperopia—esophoria 6°—right, hyperphoria ½°.
No. 4, age 13, hyperopic astigmatism compound—exophoria 2°.
No. 5, age 14, myopic astigmatism.
No. 6, age 14, hyperopia.
No. 7, age 17, hyperopia—concomitant divergent strabismus.
No. 8, age 13, hyperopia.
No. 9, age 16, hyperopia.

Group X.

Including those seventh and eighth grade pupils whose vision in the more defective eye was $\frac{20}{30}$ and better but not so good as $\frac{20}{20}$.

No. 1, age 14, hyperopic astigmatism compound—esophoria 2° —right, hyperphoria ½°.
No. 2, age 12, hyperopic astigmatism compound—esophoria 2°.
No. 3, age 15, hyperopic astigmatism compound—esophoria 8°.
No. 4, age 17, hyperopic astigmatism compound.
No. 5, age 13, hyperopic astigmatism compound.
No. 6, age 14, right eye, hyperopia—left, hyperopic astigmatism—exophoria 5°—left, hyperphoria 1°.

No. 7, age 11, hyperopic astigmatism compound—esophoria 2°.
No. 8, age 12, hyperopic astigmatism compound—esophoria.
No. 9, age 13, hyperopia—esophoria 7°.
No. 10, age 14, hyperopic astigmatism compound —right hyperphoria ½°.
No. 11, age 14, myopic astigmatism—exophoria 6°.
No. 12, age 15, hyperopia—esophoria 2°.
No. 13, age 14, hyperopic astigmatism compound.
No. 14, age 16, mixed astigmatism—esophoria 4°—right, hyperphoria 2½°.
No. 15, age 13, hyperopic astigmatism compound—esophoria 1°.
No. 16, age 19, mixed astigmatism—hyperesophoria.
No. 17, age 17, hyperopic astigmatism compound—esophoria 3°.
No. 18, age 14, esophoria 3°.
No. 19, age 13, hyperopia.
No. 20, age 17, hyperopic astigmatism—esophoria ½° right, hyperphoria ½°.
No. 21, age 15, hyperopic astigmatism compound.
No. 22, age 17, hyperopic astigmatism compound—esophoria 2°.
No. 23, age 17, right eye, hyperopic astigmatism compound—left, hyperopia—esophoria 2°.

Group XI.

Including those seventh and eighth grade pupils whose vision in the more defective eye was $\frac{20}{40}$ or better but not so good as $\frac{20}{80}$.

No. 1, age 12, hyperopia—exophoria 12°—right, hyperphoria 7°.
No. 2, age 16, hyperopic astigmatism compound—esophoria 2°.
No. 3, age 14, right eye, myopic astigmatism—left, hyperopic astigmatism compound—esophoria 5° left, hyperphoria ½°.
No. 4, age 13, hyperopia—esophoria 1°.

Group XII.

Including those seventh and eighth grade pupils whose vision in the more defective eye was $\frac{20}{60}$ or better but not so good as $\frac{20}{40}$.

No. 1, age 13, right eye, hyperopia—left, hyperopic astigmatism compound.
No. 2, age 16, hyperopic astigmatism compound—exophoria 2°.
No. 3, age 17, right eye, hyperopic astigmatism compound—left, mixed astigmatism.
No. 4, age 18, hyperopic astigmatism compound—exophoria 2°.

Group XIII.

Including those seventh and eighth grade pupils whose vision in the more defective eye was $\frac{20}{80}$ or better but not so good as $\frac{20}{60}$.

No. 1, age 16, myopic astigmatism compound—esophoria 5°—right, hyperphoria ½°.

Group XIV.

Including those seventh and eighth grade pupils whose vision in the more defective eye was $\frac{20}{120}$ or better but not so good as $\frac{20}{80}$.

No. 1, age 14, myopia—marked anisometropia.

There were none in these grades whose vision in the more defective eye fell below $\frac{20}{120}$.

PRIMARY AND INTERMEDIATE GRADES.

Group XV.

Including those pupils in the primary and intermediate grades whose vision in both eyes was normal or better, i. e., represented by $\frac{20}{20}$ or $\frac{20}{20}+$.

No. 1, age 12, hyperopia—esophoria 1°.
No. 2, age 12, hyperopia.
No. 3, age 14, hyperopic astigmatism—right, hyperphoria ½°—exophoria 1°.
No. 4, age 14, hyperopia—exophoria 3°—right, hyperphoria 2°.
No. 5, age 9, hyeropic astigmatism compound—esophoria 1°—right, hyperphoria 2°.
No. 6, age 7, hyperopic astigmatism compound—esophoria 1°.
No. 7, age 8, hyperopia—concomitant divergent strabismus.
No. 8, age 10, hyperphoria.

Group XVI.

Including those primary and intermediate pupils whose vision in the more defective eye was $\frac{20}{30}$ or better but not so good as $\frac{20}{20}$.

No. 1, age 11, astigmatism.
No. 2, age 12, right eye, astigmatism compound—left, mixed astigmatism.
No. 3, age 13, hyperopic astigmatism compound.
No. 4, age 11, hyperopic astigmatism compound.
No. 5, age 11, hyperopic astigmatism compound.
No. 6, age 10, hyperopic astigmatism compound—esophoria 4°.
No. 7, age 10, hyperopic astigmatism compound.
No. 8, age 11, hyperopic astigmatism compound—esophoria 4°.
No. 9, age 10, hyperopic astigmatism compound—esophoria 3°.
No. 10, age 11, hyperopic astigmatism compound—esophoria.
No. 11, age 12, hyperopic astigmatism—exophoria 9° right, hyperphoria 2°.
No. 12, age 11, hyperopic astigmatism compound—exophoria 5°.
No. 13, age 11, hyperopic astigmatism compound—esophoria 3°.
No. 14, age 12, hyperopic astigmatism compound—esophoria 3°—right, hyperphoria ½°.
No. 15, age 12, hyperopic astigmatism compound.

No. 16, age 13, hyperopic astigmatism compound—esophoria 1°.
No. 17, age 12, hyperopic astigmatism compound—esophoria 1°.
No. 18, age 12, hyperopic astigmatism compound.
No. 19, age 9, hyperopic astigmatism compound—esophoria 4°.
No. 20, age 11, hyperopic astigmatism compound—esophoria 4°.
No. 21, age 9, hyperopic astigmatism compound.
No. 22, age 11, hyperopic astigmatism compound—esophoria 2°.
No. 23, age 9, hyperopic astigmatism compound—esophoria 2°.
No. 24, age 11, hyperopic astigmatism compound.

Group XVII.

Including those primary and intermediate pupils whose vision in the more defective eye was $\frac{20}{40}$ or better but not so good as $\frac{20}{80}$.

No. 1, age 11, mixed astigmatism—exophoria 2°.
No. 2, age 12, right eye, mixed astigmatism—left, hyperopia.
No. 3, age 12, hyperopic astigmatism compound—esophoria 2°.
No. 4, age 14, hyperopic astigmatism.
No. 5, age 12, hyperopia.
No. 6, age 12, hyperopic astigmatism compound—esophoria 1°.

Group XVIII.

Including those primary and intermediate pupils whose vision in the more defective eye was $\frac{20}{60}$ or better but not so good as $\frac{20}{40}$.

No. 1, age 10, myopic astigmation compound, esophoria 4°—blepharitis marginalis.

There were none whose vision in the more defective eye was $\frac{20}{80}$ or better but not so good as $\frac{20}{60}$.

Group XIX.

Including those primary and intermediate pupils whose vison in the more defective eye was $\frac{20}{120}$ or better but not so good as $\frac{20}{80}$.

No. 1, age 13, myopic astigmatism compound—esophoria 3°.
No. 2, age 9, hyperopic astigmatism compound.

Group XX.

Including those primary and intermediate pupils whose vision in the more defective eye was $\frac{20}{200}$ or better but not so good as $\frac{20}{120}$.

No. 1, age 19, Nystagmus—the muscles, of course, could not be tested.

There were none whose vision in the more defective eye fell below $\frac{20}{200}$.

Table I shows the percentage of pupils from the three departments of the school, normal, grammar and intermediate with the primary, found in the eight grades of vision.

TABLE I.

Vision.	Normal Department.	Grammar Department.	Intermediate and Primary Department.
$\frac{20}{20}$ or better	14.39%	21.42%	19.04%
$\frac{20}{30}$ or better but not so good as $\frac{20}{20}$	51.75%	54.76%	57.14%
$\frac{20}{40}$ or better but not so good as $\frac{20}{30}$	12.06%	9.52%	14.28%
$\frac{20}{60}$ or better but not so good as $\frac{20}{40}$	7.78%	9.52%	2.38%
$\frac{20}{80}$ or better but not so good as $\frac{20}{60}$	2.72%	2.38%	0%
$\frac{20}{120}$ or better but not so good as $\frac{20}{80}$	2.72%	2.38%	4.76%
$\frac{20}{200}$ or better but not so good as $\frac{20}{120}$	4.28%	0%	2.38%
Below $\frac{20}{200}$	4.28%	0%	0%

From Table I it is seen that the percentage of pupils with normal vision in both eyes is much greater in the grammar grades than in the normal department, and, while the percentage in the intermediate and primary is less than in the grammar, it is still markedly above that in the normal school.

A larger number of pupils from the lower grades will have to be examined before a positive statement can be made regarding the comparative vision of pupils in the grades.

This investigation, indicates however, that there is a steady decrease in the acuteness of vision of pupils as we advance from the lower grades to the higher and to students of the age of those who are in the normal department.

This view is strengthened by combining those coming within the first three groups, *i. e.*, those whose vision is between $\frac{20}{20}$ or better and $\frac{20}{40}$, and also those whose vision falls below $\frac{20}{40}$. This is shown in Table II.

TABLE II.

Vision.	Normal Department.	Grammar Grades.	Intermediate and Primary Grades.
$\frac{20}{20}$ or better to and including $\frac{20}{40}$	78.21%	85.71%	90.47%
$\frac{20}{40}$ to $\frac{20}{200}$ or below	21.78%	14.28%	9.52%

Table II shows that the number of normal students whose vision is $\frac{20}{40}$ or better is markedly less than in the grammar

department, and the number in the grammer grades is again greatly exceeded by those in the intermediate and primary. The same difference is shown when we consider those whose vision falls below $\frac{20}{40}$. The percentage in the normal department is largest, followed by the grammar grades, while only 9.52% of those examined from the intermediate and primary grades come into this group.

The results of this investigation would seem then to justify the conclusion that about fifty per cent. (50%) of all pupils have at least one eye whose vision is not normal but falls somewhere between this and $\frac{20}{30}$. There also appears to be a decrease in the acuteness of vision as we pass up the grades.

The number of pupils with anisometropic eyes did not differ greatly in the grades and normal department. The degree of anisometropia, however, was noticeably greater among the older pupils and students, leading to the conclusion that continued use of unlike eyes without correction increases the difference. This is probably due to the fact that the poorer eye does little or no work and so gradually loses its power.

But little attention has thus far been given to correcting the defects in the eyes of children. It is not unreasonable to assume that this neglect is one cause of the increase of eye troubles among older pupils. This eye strain is undoubtedly a fertile field for many other ailments.

"Jessup reiterates the well known fact that persistent and recurring headaches in young persons and in those near the presbyopic age are in many cases due to an error of refraction, weak accommodation, and anomalies of the extrinsic muscles. Mittendorf reports four thousand (4,000) cases of headache that were relieved by the correction of optical defects. . . . Coover details fifteen cases of reflex irritation following eye strain. Among the prominent symptoms, all relieved by full correction, are attacks of convulsions resembling epilepsy, caused by continued use of the eye at the near point. Headaches, vertigo, nausea, constant pains over the brows and occiput, restlessness, melancholia, loss of appetite, faintness, insomnia, palpitation of the heart, chorea, stammering, cough without expectoration, irritation, thickness of speech and numbness of the hand and tongue, mental confusion, backaches, dyspepsia are numbered among the symptoms."[1]

Any defect of the eye which must be overcome before clear vision is possible constantly draws from the nerve centers more force than the center can healthfully supply. "For example, a short superior muscle in one eye requires many times the

[1] "The American Year-Book of Medicine and Surgery," 1897, pp. 893, 894.

amount of nerve-force to perform the function that the centers were ever intended to furnish."[1]

An interesting fact, though by no means a new one, was repeatedly observed. Young boys and girls with more defect than some older ones had never experienced any trouble with their eyes, while the older ones, with much less defect, were constantly annoyed by eye ache or the blurring of the letters. The difference was that the vigorous nervous system of the young boys and girls was able to sustain the irritation of the poorly constructed eye and, by an over generous supply of nerve force, could compel the eye to do its work without apparent injury, while the more exhausted nerve centers of the young men and women could not stand the constant call for more energy. "Disease is localized abnormal innervation and always central in the nervous system, being a lack or excess of motive force."[2] It should not be forgotten, however, that eye strain is a potent factor in this disturbance of the nerve centers.

The prevailing belief that glasses should never be worn by children prevents their eyes from receiving the attention needed. If the eye cannot perform its work without constantly calling for more than its share of nerve energy, it drains the vitality and deprives other parts of needed nerve-force. "Ingalls pleads for the early correction of ametropia, declaring that it is a waste of time to send a child to school when his eyes are not in proper condition to do the work assigned."[3]

If the vision is good we are satisfied and give the matter no further attention. We forget that the eyes may be using up an excessive amount of nerve force. "Long years of effort are made by defective eyes to perform the function of vision as perfectly as possible. When necessary, the nerve centers innervate to their utmost power the various eye muscles, causing a change of shape in the crystalline lens, stretching muscles which were too short, to enable the eyes to look in the same direction."[4]

Many of the most serious muscle defects are not manifest. The eye is held in perfect balance with no apparent irregularity. The defect is "a fixed abnormal innervation" constantly drawing from the nerve centers energy that cannot well be spared.

"The year has brought forth an avalanche of evidence to the effect that no department of preventive medicine is more important than the correction of anomolies of refraction and of muscular action. Doubt must give way before the brute force

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[1] Prentice. "The Eye in its Relation to Health," p. 24
[2] Prentice. "The Eye in its Relation to Health," p. 40.
[3] "The American Year-Book of Medicine and Surgery," 1897, p. 892.
[4] Prentice. "The Eye in its Relation to Health," p. 10.

of such an array of facts. If permitted to continue in the child and youth, eye strain means neurasthenia in the adult."[1]

Latent defects are often far more serious than those that are manifest, because they never allow the eye any rest, while manifest defects give periods of relaxation. Dr. Prentice says, "the highest state of nerve disturbance exists where the defects are absolutely latent or their manifestation reversed." This excessive eye strain "depletes the nerve centers. It also gives rise to brain irritation of varying degrees; dispositions are altered by it; character is forcibly changed."

Hyperopia is perhaps the most common defect in the eyes of young people. Its tendency to remain hidden and disclose its presence only to trained specialists makes it especially difficult to conquer.

The hyperopic eyes of children and young men and women are often unusually acute in vision. Not infrequently they see better than normal. So common is this defect that Berry maintains that "the eyes of new born infants are almost invariably hypermetropic." The frequency of hyperopia does not, however, lessen its injurious effect. Hyperopic eyes are under a continual strain from the moment they are opened in the morning until they are closed at night.[2] This strain is the same for distant objects as that of a normal eye at the near point. We should feel that our eyes were too severely taxed if we should read all the time and yet the hyperopic eye is under this same strain during the entire day. When reading, the hyperopic eye has to add the usual effort to the ciliary muscles. thus doubling the strain.

Slight esophoria has been relieved by the correction of hyperopia, and that dreaded disease, glaucoma, is sometimes occasioned by this same strain in the ciliary muscles.

Prentice is of the opinion that myopia "takes its origin nearly, if not always, as hypermetropia," in which the nerve impulse that corrected this defect exceeded its purpose.

If "what is termed organic disease really consists of some lesion of the parts which is the result of continued imperfect or erratic function," and "if in the true sense lesion is not disease but the result of disease," it is of vital importance that disturbing pathological conditions be remedied before they become the cause of reflex diseases through continued irritation of the nerve centers. The nice correlated action of perfect anatomical structure may be found under the most abnormal conditions, but only at a tremendous outlay of nerve force which must ultimately destroy the equilibrium of the centers.

[1] The American Year-Book of Medicine and Surgery. 1897, p. 891.

[2] In hyperopia and muscle trouble fixed abnormal innervation sometimes exists even during sleep.

All parts of the body are acted upon through sympathy, but just that delicate structure of the eye which renders it so sensitive to the most subdued form of energy, makes it also most susceptible to conditions within and without. One defect occasions others. We have seen this illustrated in the various derangements of the eye resulting from hyperopia. Muscle trouble is no less comprehensive in its influence. "Corneal astigmatism is almost always due to the fact that some of the muscles of the eyeball are exerting greater tension in one meridian than another." [1]

Since the visual centers are the most sensitive and the most continuously active, it is of the utmost importance that they do their work with the least possible friction. Constant irritation always ends in an irritable nerve center which responds by sending out abnormal nerve impulses that end in what we call organic disease.

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[1]Prentice. The Eye in its Relation to Health, p. 152.

NUMBER AND ITS APPLICATION PSYCHOLOGICALLY CONSIDERED.

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I. The Background of Our Number Concept.

In the consideration of the subject now to be discussed, I propose to introduce and co-ordinate several phases and considerable work not yet found in any single treatment of the subject; to present a brief digest of the leading lines of thought on Number and Mathematics for primary and secondary schools from the pedagogical and psychological standpoint; and, lastly, to present my original investigations. Whatever merit may attach itself to this article I believe the greatest will consist in bringing together considerable material generally ignored or overlooked in treating the psychology of number, and in the *genetic treatment* of the subject. It appears that the most natural treatment will be to consider (1) the background of our number concept, (2) its development, (3) the original investigations, (4) the special application of the number concept to arithmetic, (5) the conclusion.

I will first review some experimental work which at first thought may appear to have little to do with the question under consideration, but which really underlies the whole psychology of counting. In 1868 Vierordt experimented on time-impressions from the beating of a metronome, reproducing them after the lapse of a short period. The indifference point, the length of interval more easily and accurately judged than any other above or below, was not the same for each individual, but varied between 1.5 sec. and 3.5 sec. For himself this interval was from 2.2 to 2.5 sec., when through the sense of hearing,[1] and twelve impressions could be distinguished if caught in a certain rhythm. Mach performed some experiments by the method of just perceptible differences as to the recognition of the equality of two time intervals. It was found to be most accurate at about .37 sec. and in proportion as one varied from this standard it was necessary to increase the difference between the standard and the interval for comparison in order to recognize their equality.[2] Kallert carried on several similar experiments in

[1] *Wundt's Phys. Psych.*, S. 781.
[2] *Wundt's Phys. Psych.*, S. 785.

Wundt's laboratory, where two metronomes were used; one giving off a constant series, and the other varied intervals for comparison with the standard. Experiments on seven persons for intervals from .4 to .5 sec. showed the indifference point to be between .7 and .8 sec.[1] Estel and Mehner fixed the indifference point at .71 sec., and treated of the multiplication of the indifference point.[2] Dietze performed some experiments to determine the greatest number of metronome beats that could be repeated, and could be recognized to be the same in the repeated as in the original series. The largest series tended to group themselves into rhythmic multiples which he thought could not be suppressed. The largest number was forty and obtained by five groups of eight each.[3] Most of the experiments mentioned above were performed in Wundt's laboratory and under his directions.

Mr. Stevens published in *Mind* the result of 135 experiments on seven different individuals. "Of these, 114 point to this fundamental principle: That there is an interval of time (the value of which varies between .53 and .87 sec.) which can be reproduced with considerable accuracy; but with all other intervals an error is made, which is *plus* for those above and *minus* for those below the indifference point, the average of which was about .71 sec."[4] The direction of the variation as stated here is directly opposite that found in all of the experiments above mentioned, but the methods were different.

Dr. Hall and Prof. Jastrow performed a series of experiments by setting up a number of cogs following no order. One cog was put in as an *avertissement* at the most favorable interval of about .75 sec., and the observer sought to count the clicks. Each series of observations was preceded by a preparatory series of clicks which was arranged so as to exclude any considerable variation, and thereby largely eliminate the element of fatigue. After sufficient revolutions of the drum to satisfy the observer, the record was taken and another number set up. From this work it is concluded that counting objects or impressions is a very complex process, that "impressions in a series must be distinguished from each other, that from 20 to 40 beats per sec. can be distinguished by the average ear without passing into one tone, that 4 or even three clicks must be farther apart than two, that counting requires a series of innervations, if not of actual muscular contractions, and the matching or pairing of the terms in two series in consciousness; that counting is more

[1] Philosophische Studien, Bd. i, Heft. I, S. 88.
[2] Philosophische Studien, Bd. ii, Heft. I, S. 37; and Bd. ii, Heft. 4, S. 546.
[3] *Wundt's* Philos. Studien, II, 362.
[4] *Mind*, Vol. XV, p. 394.

than tallying by ones ; it is giving names to each position in a series. These names are difficult to pronounce, and some become more prominent by means of the greater time or effort they require. This in part accounts for the tendency to count with a system of accents. When the observer is behind in counting and clicks appear to be lost, he has ceased to give attention to the auditory series, having caught the *tempo* in the beginning and perceives only the innervations which expand all short intervals." [1]

Dr. Nichols has made a review of the work on these lines in his article on The Psychology of Time, and concludes that nearly all persons, under nearly all conditions, find a particular length of interval more easily and accurately judged than any other, that this interval is very variable for different individuals, that the sign of the Constant Error is usually constant in both directions from the Indifference Point, that, when the norm and reproduction are single, the Constant Error is minus for intervals longer, and plus for intervals shorter than the Indifference Point, when the norm and reproductions are multiples, we have exactly the reverse.[2] Later, Dr. Nichols, after some very extensive experiments, asserts this same individual variation, finds the Indifference Point to be about .81 sec., and concludes that "time measurements are memories of certain most striking rhythmical, habit-inducing, and oft-occurring outer occurrences, such as particular watch or clock strokes, the varying lengths and shadows of morning, noon and night, etc." [3]

Dr. Nichols has lately published a small work on Our Notions of Number and Space. It is founded on a great number of tests made on the tongue, forehead, abdomen, etc., with pins in a cardboard. From two to five pins were used, arranged in lines, triangles, squares, etc. On the whole four pins were guessed more frequently than 3 or 5. "The more distinct and differentiated the separate terms of a presentation become, the more distinctly do they become numerical presentations. To formulate the genesis of numerical presentation we must determine the laws governing the simultaneous and successive combinations of separate points. The greater the number of points in any given distance the less accurate and clear these numerical presentations, and vice versa." [4] Small numbers were over-estimated, and large ones under-estimated. "Its origin and foundation must be fundamentally placed in the following law : Presentation of Numbers, of Distance, and of

[1] *Mind*, Vol. XI, No. 41, pp. 57–61.
[2] *American Journal of Psychology*, Vol. III, p. 529.
[3] *American Journal of Psychology*, Vol. IV, p. 107.
[4] Our Notions of Number and Space, p. 184.

all Spatial Figures, and arrangements in general are alike based, primarily, upon serial events, differing greatly in mode, such as become characteristic of those modes of presentation which we call numerical, external and spatial, but all of them governed by the same fundamental laws of relationship. By reason of this, *all simultaneous presentations are dependent upon, and expressive of, the several modes of serial occurrence out* of which, through life, they have evolved, and become differentiated." [1]

Again, the work on Rhythm, by Dr. Bolton, will be seen to bear strongly on this subject. The preliminary part calls attention to the rhythm in the pulse, respiration, walking, speaking, attention, etc. In respiration the rhythm is about 15 to 20 minutes apart, the simplest voice utterances are primarily rhythmical. Nothing is more striking than the effect of rhythm on children and savages, and no one can avoid the moving of muscles when the rhythm is strong and clear. The instrument gave opportunity for variation in intensity at any place, and intervals of time could be made between 2, 3, 4, 5, 6 or 8 clicks. The rhythmical grouping of sounds was the same *in every case*, and the same was found by Deitze in the work to which I have already referred; and Wundt thought it impossible to *restrain* this grouping absolutely. It is done by intensifying certain sounds and subordinating others. Many say it is the same peculiar periodicity as they observe in the ticking of a clock. Others, when asked to count them, said they counted 4 or 2 as the case might be and began again. The subjects were found to be unconsciously keeping time by tapping, nodding, etc., at every second or fourth click. When movement was restrained in one muscle it was likely to appear elsewhere. These movements are the condition of rhythmical grouping. The accented sounds occupy the first place in the series and the 4-group appears to be composed of two 2-groups. "The conception of a rhythm demands a perfectly regular sequence of impressions within the limits of about 1.0 sec. and 0.1 sec." "When attention is moderate the number of clicks falling into groups vary with the rate. Slower than a certain rate no rhythm is felt. With more rapid 2 clicks form a group. Faster still, 4 clicks form a group." [2]

Bechterew found that with two series of strokes, of which one was larger than the other, coming simultaneously at the most favorable rate of 0.3 sec., he could distinguish a group of 18 from one of 18+1. [3]

Several tests have been made regarding the eye-span. "If

[1] Our Notions of Number and Space, p. 200.
[2] *American Journal of Psychology*, Vol. VI, pp. 145–237.
[3] James' Psychology, Vol. I, p. 407.

you throw a handful of marbles on the floor," says Hamilton, "you will find it difficult to view at once more than six, or seven at most, without confusion, but if you group them into twos, threes, or fives, you can comprehend as many groups as you can units; because the mind considers these groups as units."[1] Prof. James says: "If a lot of dots or strokes on a piece of paper be exhibited for a moment to a person in *normal* condition, with the request that he say how many are there, he will find that they break into groups in his mind's eye, and that whilst he is analyzing and counting one group in his memory the others dissolve. In short the impression made by the dots changes rapidly into something else. In the trance-subject, on the contrary, it seems to *stick;* I find that persons in the hypnotic state easily count the dots in the mind's eye so long as they do not much exceed twenty in number."[2]

Jevon threw beans into a box and found that 3 and 4 were always guessed correctly, 5 correctly 102 times out of 107, and 6, 120 times out of 147.[3] Mr. Cattell exposed to the eye for .01 sec. cards with short ruled lines, varying from 4 to 15 in number. With 4 or 5 no mistakes were made, but for higher numbers the tendency was to under-estimate rather than over-estimate. He tried similar experiments with letters and figures, with practically the same results.[4]

Schumann made some experiments on memory in which letters were posted at regular intervals on a revolving drum, and observed through a slit. It was observed that when any rate was attended to for sometime, any change in the rate caused errors in judgment that would not have existed had the previous adjustment not occurred. The same was found to be true with metronome beats. He thinks the sensory centers are the seat of these phenomena, that they adjust themselves to a given rhythm, and rather expect excitations at a given time. Similar errors were found in measuring by drawing the fingers along a scale by motion of the arm.[5] Bourdon tested 100 children from 8 to 20 years old by pronouncing random figures, letters, and syllables, at the rate of 100 per minute. Ninety-four could reproduce accurately 5 figures. Six, seven, and eight were reproduced by only a few. Figures were much more easily reproduced than letters or syllables, and the power improved a little with age.[6]

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[1] Lectures on Metaphysics, Lecture XIV.
[2] *Psychology*, Vol I, p. 407.
[3] Nature, Vol. III, p. 281.
[4] Philosophische Studien, III, 121 ff.
[5] Psychology of Time, by Nichols, *American Journal of Psychology*, Vol. III, p. 522.
[6] Philosophique, Aout, '94.

Dr. Bolton performed some experiments on the Memory-Span in children, by reading miscellaneously numbers about two-fifths sec. apart. He concludes that the memory-span increases with age rather than with intelligence, that for pupils of public schools it is six, and that the power of visualization plays an important part.[1]

Mr. Johnson has given us the results of similar tests on Feeble-Minded Children in which it appears that some groups surpass the normal children of same age as given above by Bolton and Bourdon, but the average falls below that of normal children. The tables indicate some relation of memory-span to intelligence, yet it is so high that we cannot consider it commensurate with the degree of intelligence. They are ear-minded rather than eye-minded.[2]

In and back of the material that is herein presented we are to seek the proper approach to the whole subject of Numbers if we are ever to treat them in a psychological and pedagogical manner, and to throw light on the most poorly taught subject in our schools. In most treatments on this subject a mistake is made in treating it either from the standpoint of adult psychology, sometimes philosophy, or in considering a concept as having a sudden birth, rather than stages of development. That the concept makes its first appearance in consciousness with the word or language symbol that represents it is a pedagogical misconception once very prevalent, and yet assumed by many who have written on the subject of Number and Mathematics. In Dewey and McLellan's practical part of The Psychology of Number one would infer that they believe that the child enters school with a very low, if any, number concept.

Again there is too much tendency to treat certain concepts or ideas as having their origin wholly in a single sense; such as time to the ear, space to muscular movement, and number to the eye. Without doubt the evolution of individual concepts is the proper approach to intellectual evolution, and the concepts now so vivid to man doubtless have a long and interesting history in their development through the lower animals, and in the race, which somewhat corresponds to their continual development in the individual from the dawn to the close of life. Before we can clearly discern the fundamental character that distinguishes one concept from another we must at least consider its evolution in the individual. In most, if not all, of our concepts it will be found that different senses play an important part in their formation, that they are fed, not by a single stream, but by several, and pass through various metamorphic periods.

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[1] *American Journal of Psychology*, Vol. IV, p. 363.
[2] PEDAGOGICAL SEMINARY, Vol. III, p. 246.

Sight plays such a dominant part in the development of the number concept that most have sought its origin in the observation of things. Dewey and McLellan assert that numbers are not obtained from things, but put into things. "The idea," they continue, "that number is to be traced to measurement and measurement back to adjustments of activity, is the key to the entire treatment of number as presented in these pages."[1] That is to say, our number concept is developed from our necessity to measure things. Civilization imposed upon us this necessity. Had they called the chapter on the *Origin of the Number Concept* the *Development of the Number Concept* it would have more nearly included the facts. But it is absurd to think of a savage attempting to measure a given quantity without any concept of numbers.

Lefevre, whose work is in many respects scholarly and unique, says: "Primary number (the early number concept) is a normal and universal creation of the human mind; it is purely the product of a rational process — an abstraction from a group of objects which represents their individual existence. The concept *one* is only in contrast with the concept *many*. The fundamental concept is prior to, prerequisite for, not derived from, counting."[2] To say that it is a "normal and universal creation of the human mind" is only to drop into the old way of dodging psychological difficulties. In the above quotation we have the inference that recognition of numbers in groups is the necessary stage out of which counting is developed. Most teaching of numbers is now founded on such a supposition, the falsity of which I shall speak later. Concerning the ratio or measuring idea, the *rational process*, on which both of the above works are based, I will show hereafter that such has a place, but that it is a totally different thing from the number series.

"By number," says Schubert, "we understand the result of counting or enumeration, which involves the ordinary or number sign, and the word standing for the thing counted; as five men, seven cities, and to ascend from named to unnamed numbers the notion of addition is necessary."[3]

This is sufficient to present the general drift of most discussions on the origin of the number concept, and before following this line further I wish to show the rudimentary stages that are prerequisite to this part of the subject, and then to co-ordinate this in its proper place. They would have done well had they not seized upon a part of the problem as the whole of it.

The first step is surely the formation of a series-idea. Changes in consciousness are continually taking place, produced

[1] Psychology of Number, p. 52.
[2] Number and its Algebra, p. 20.
[3] *The Monist*, Notion and Definition of Number, April, 94.

by the varying impressions from all the senses. Consciousness is not one continuous impression but an innumerable multitude of successive changes. Which one of the senses plays the first and most important part in the series-idea, we are perhaps unable to determine. We cannot go as far as Preyer, who claims that the number concept is derived from the sense of hearing; or Munsterberg, who appears to derive time chiefly from the rhythmic processes of breathing; or Mark, who says that time is the result of the consciousness of continuous metabolic changes; or, like Nichols, find the origin of space and number in touch. As already stated, without doubt different senses contribute to these ideas. The tactile sense very early produces an endless series of changes in consciousness which soon become vaguely recognized as distinct both in time and space; sound continually plays its part after the first few hours of life; random noises, voices, ticking and striking of the clock, all contribute to the formation of the series-idea; the succession of night and day continues to greet the eye, objects come and go before the field of vision; hunger and satisfaction periodically occupy a place in consciousness; functional processes, especially circulation and respiration, play an important part, the movements of a child, first by others, then its own — all these, in process of time, establish firmly the series-idea which exists long before the number-name series. The earliest and most rudimentary form of knowledge in the cognitive sense is a knowledge of a series of changes. This precedes all external knowledge of things.

Since most of the foregoing experiments relate to time, the question as to what this has to do with numbers has naturally arisen. Simply because they have primarily the same origin and are fundamentally the same. Many errors arise simply because such abstract notions are considered under the form in which they occur most frequently in adult life. Although time and number may seem now quite distinct, yet these abstract notions have more in common than is usually supposed. Certain number of clock spaces or of passing events give us a time measure. The hunter or laborer depending upon measuring the distance of the sun from the horizon, is entirely lost if clouds obscure the sun. The power to measure a certain time in hours or days depends upon the power to reproduce the events that have occurred during its lapse. The aged, being unable to remember the passing events, have little sense of time. Some series of succession is the norm by which we judge time. Time is also used to express number; a day's journey once stood for a definite number of miles. Some savages use the seasons and the days of the moon to designate certain numbers. "Representing equal units, and groups of equal units, of any order

whatever, and being, as it were, created at any moment for the purpose of calculation, numerical symbols," says Spencer, "seem, at first sight, independent alike of space and time. The fact is, however, exactly the reverse."[1] "The conception of both number and motion," says Ladd, "involves both space and time."[2] Figures or symbols are applied indiscriminately to any series of successions. Later we shall see that some of the strange mental phenomena in the application of numbers, and perhaps the relation of geometry to other mathematics, are traceable to the fact that this series-idea, established by a series of outer existing occurrences, embody the rudiments of the time, space, and number concepts.

This series-idea, established by a multitude of successive and rhythmical sensations conveyed through the different senses, ceases to be symbolized by different touch sensations, circulation, breathing, and movements, by sounds, clock strokes, etc., by varying objects in the field of vision, and becomes a general idea applicable to any series of successions. That this series-idea is the first step, and that it becomes quite abstract, will appear evident when all of the facts are co-ordinated. Long before there is any conscious idea of number, children delight in reproducing or following a series of any kind. I have recorded 91 striking cases of this kind. Watch them throw down a given number of blocks time and time again, repeat a series of sounds; several record cases where children repeat the strokes of the clock, sometimes very accurately. A boy under two years of age rolled, one after another, ten mud balls down an incline, marking one each time until all contained a little cross. The successive nods or motions of the head that children so often go through before any attempt to count, are the same that nearly all children make in counting. Behind such activity the series-idea is manifest. But mathematical prodigies and savages furnish unmistakable proof of this early stage in the origin of our number concept. The former have the series-idea highly abstracted and developed before any names are given to the series. When Mondeux and others spent their early days in arranging and piling up pebbles, they were not forming a number concept, but simply endeavoring to symbolize the steps in the series-idea. Many of their combinations made without any knowledge of number names are astonishing. Mondeux said: "I did not know there was such a word as multiply, but I made my tables with peas and pebbles."[3] He could neither read nor write, and knew no symbols such as we use, when Jacoby found him. Inaudi, whom Binet has

[1] Synthetic Philosophy, Vol. II, p. 38.
[2] Psychology, Descriptive and Explanatory, p. 499.
[3] Scripture, *American Journal of Psychology*, Vol. IV.

examined very extensively, first used *any* words, then learned the number names from 1 to 100 from his brother, and demanded more. He was then only six.[1] Without number names he performed calculations that to most would appear wholly incredible. At the age of 3 years Gauss is said to have corrected his father who paid his servants at evening and for extra hours. Fuller, Ampère, Bidder, Mondeux, Buxton, Gauss, Whately, Colburn, and Safford learned numbers and their values before figures. Why are children so eager for number symbols? Many want the "last number," but are never satisfied with any number given. Dr. T—— says his little girl has very much annoyed them by asking for the last number. Number names neither mark the origin nor limit the number concept.

Prof. Conant says that no tribes have been discovered to be without some number concept. But it is often limited to the numbers 1 and 2, or 1, 2, and 3.[2] Here we have a work that is a misnomer, since it deals only with the naming of the series. No one has any right to suppose a savage tribe cannot count beyond the current words for numbers. In fact they can and do count further by the gesture language.

I now wish to show that this series-idea becomes abstract, and hence some symbols of representation are necessary. Numerical symbols must be considered as purely representative. So are the fingers, sticks, notches, pebbles, etc., of the savage and the mathematical prodigy. How many other forms of rudimentary representation there may be we cannot tell. One can easily conceive that the difference of the strain of consciousness in grasping two series, or different successions, might roughly stand as a symbol. The child that has never seen but *one* dog cannot, in any sense, have what we call the abstract idea "dog." It is only after many and different kinds have been observed that the idea ceases to represent some particular one or quality. When there is a rapid presentation of many objects belonging to a class the marks are most likely to go unnoticed and an abstract idea is unconsciously formed. Suppose no name is given to these presentations; nevertheless the idea would be gradually forming and most likely to be symbolized in its first stages of development. The abstract series-idea has a similar evolution, only much more complex, less conscious, and more highly developed. It may be well to note here that in speaking of the abstract series-idea I do not mean it in the sense in which we speak of the abstract notion of virtue or of God. But such is more in the nascent and un-

[1] Psychologie des Grand Calculateurs, p. 28.
[2] The Number Concept—its Origin and Development.

conscious period of development. It is the inheritance of latent experiences, of an infinite repetition of them, implanting the vague idea of an endless succession. It corresponds to the vague abstraction which children show in applying strange names to common objects. Succession of some kind is the earliest and most continuous thing in consciousness. Series of innervations, touches, sounds, sights, etc., are the most constant things in consciousness; one series only gives way to another. Of course we are now speaking in terms of a rudimentary consciousness, and in going back to such a stage one is most likely to carry with him his present mental habits; and, since the eye symbols are so much more convenient now, and have such an irresistible influence over our concepts, it is hard to recognize that it has ever been otherwise and that there has been a gradual substitution. Thought is carried on in substituted symbols almost to the entire exclusion of the original ones, and without recognition that they derive their meaning from other sources at an earlier period. Certainly the prevailing opinion is that the number concept is derived through the sense of sight by the observation of things, or comparison of quantity. To what serious pedagogical and psychological mistakes this may lead is readily observable.

On what other ground than that which has been presented can we explain the facts as we find them in children? Children first name the series without reference to objects of any kind. Every attempt to instruct children in numbers shows that the series-idea is highly abstract. On making a test of 39 children in the kindergarten, I found that 33 of them counted without the slightest reference to the objects to be counted, always running the series far ahead of the objects. Nearly every primary teacher I have consulted says that for sometime children count in this manner, and the same is confirmed in the 616 returns to be considered later. Three hundred and fourteen out of 341 answering this question say the series gets ahead. Of the 39 mentioned above I found that all but two could count 100, yet their teacher said she had no idea they knew any number beyond 10. "M—— knew number names long before numbers themselves, and applied them to anything indiscriminately, the number seldom agreeing with the number of objects; when she was only five she begged to be told 'all the numbers there are.'" Mathematical prodigies, as already pointed out, have the series-idea most firmly fixed, and to them it generally remains a meaningless abstraction. Again children have regard for only the rhythmical order of the number names. "Paul being asked how many puppies the next door neighbor had, replied that he had three. His father said he had four. The child said 'No,' and proceeded to count as follows: 'Tip is naught,

Bob is one, Nero is two, and Dandie is three.'" The use of naught for one is not uncommon. Have children of the kindergarten count, and you will find that they leave out difficult names and carry on the series the same, often repeating without being conscious of it. One boy asserted his ability to count 100, but in seven trials he never got beyond 69, always going back to 30. He still thought he counted 100, and appeared to have no idea that he repeated. "M—— when learning to count things or impressions would count eight, nine for one object. The number series always get ahead." "This child learned the figures in order: *i. e.*, 1, 2, 3, 4. He could tell them in this way up to forty, but if they were changed around he would not know but what it meant the same; he associated number with place or order only." "Most children I have taught," says an experienced teacher, "*will* learn the names independent of things. For sometime they do not associate them as how many of anything, but merely the name of the series." A—— writes: "I knew a little girl who was taught the figures in this way because they were easier to make: 1, 4, 7, 9, 10; afterwards, 2, 3, 5, 6, 8. For a long time the child would count 1, 4, 7, 9, 10, 2, 3, 5, 6, 8."

I cite in this connection the following statements collected from experienced teachers: D——. When the objects were beyond his counting series, R—— would look ahead, and finding this to be the case would group two or three objects as one to come out all right. F——. They use them promiscuously. Freddie counted seven sticks; when his mother changed the order, he counted them thus: 3, 4, 1, 2, 5, 6, 7. C——. In nearly all of my experience with little children I find that number names are used as names alone, and thus the third one in a series of objects will be a three to the child, no matter if it be taken from the series or not. L——. I placed little sticks before Willie and told him to touch each stick as he counted, but he was just as liable to touch three when he meant six or any other number. W——. Children learn number names as they learn other words, by hearing them repeated. They use them without knowing their respective values. They apply them promiscuously calling three objects ten as the case may be. Very frequently they have the idea that the number name belongs to the object in whatever order among others it is placed.

The early period at which children learn to count is very significant. They learn to name the series and follow it before they learn letters, to read, or to write. Out of over 1,100 persons, 90% are sure that they learned to count first. The supervisor of one of the large normal kindergartens writes as follows: "The tiniest children in our lowest room could count perfectly as far as eight, giving the names in order, and pro-

nouncing perfectly after the first three or four weeks in school. I was surprised, for I knew that most of these sounds were not associated with any idea of number. I was curious to find out the reason for this occurrence and soon came upon it. The girl teaching in the room counted for gymnastics. The great enjoyment which these little people took in those eight words suggested to me that perhaps it was not so wrong as we have been told to teach children counting. The smaller children often carry on this counting to themselves after being seated, counting over and over. From the movement of their lips I can see that the charm is still upon them." This same delight is manifested until children are 8 or 10 years old.

A passion for counting when children first learn to follow the series is very common; 131 cases are reported, many of which are very interesting. J——. A little girl of seven years seemed to have an absorbing passion for counting everything. One day when at the Township Fair she counted all the chickens. She was once sent on an errand with the injunction to hurry. On the way home she walked on the railroad track and counted the ties. When half way home she forgot the number, so retraced her steps a half mile, and counted them again. M——. Lucy, 6 yrs., having been turning the leaves of a new copy of Webster's International Dictionary, turned to me saying—"This dictionary has —— pages." I noticed that she read the number of the last page correctly. "Well, Lucy, how many leaves has the dictionary?" Her answer was a little laugh and "O, don't know, a great many. There are over a thousand." My approval delighted her, and she told me of her self-imposed task of counting a million. "I have counted to seventy thousand." "You have?" "Yes, I am counting a million." "How long will it take you?" "O, I don't believe I ever can, it will take such a long time. I have been counting a long time," she said. An older sister of whom I inquired, thought that she had been counting for nearly a year. In several schools which I have visited, teachers have departed from their usual way of teaching by blocks, etc., just to show what a delight children take in counting. Why is this series named so early? Why such delight in counting? Why should these words be sought and caught so readily? The abstract series is behind it. The child is only keeping up the various activities of following an indefinite series in the various ways before mentioned, by a more convenient series of symbols. But the old signs are not lost at first.

A movement of some muscle, as the toe or finger, or nodding of the head, can be observed in nearly all children when counting at first. In fact many adults consciously or unconsciously do so.

J——. When I was small I always used my fingers to count.

In fact am inclined to do it still, so strong is the habit. When the teacher forbade it I used my toes, moving them inside my shoes sometimes; at other times I remember producing a little sound in my throat as a counter. Again, when alone, I was addicted to tapping my fingers in succession. When I wished to remember I always counted off on my fingers in some way that it would be clearly stamped upon my mind. G——. Have seen children who were forbidden to count on their fingers make pressures upon their legs and sides with fingers or elbows. A——. Used to tally with my little finger, but not allowed to do this, I tallied by rubbing two of my back teeth. F——. When counting I tap one foot against the other for every count. L——. When 14 years old was greatly embarrassed upon finding all the boys in school laughing at me. Upon investigation, found that while doing an example I counted everything up on my fingers. This revealed a habit which I was entirely unconscious of. D——. In adding numbers greater than three I would always nod my head first toward one side then the other. I stopped that, for a long time I would think of nodding, but not really do so. In Bolton's work on counting clicks the subjects nodded or moved some muscle. If suppressed in one muscle it was likely to appear in another.

The fact that, at least nearly all children, no matter how taught, first learn to count independently of objects, in which the series-idea gets ahead, that they recognize three or four objects at first as individuals, calling the fourth one four even when set aside by itself, that counting proceeds independently of the order of number names, and often consists in a repetition of a few names as a means of following the series, that children early desire and learn these names; such, taken with the earlier steps presented, furnish unmistakable evidence that the series-idea has become an abstract concept. This is an important fact, the full significance of which will become manifest later.

Before passing to the next step, which is the naming of the series, let us call attention to certain rhythmical processes that must not be ignored, and which all the experiments on counting clicks, etc., show. Whatever fault may be found with these experiments it is evident that there is a favorable rate above and below which error is much more frequent, that it varies somewhat in different individuals and for the different senses, that the multiples are of great importance, that certain grouping is hard to avoid, and that accenting of certain numbers in the series and varying of the rate tend to modify the groups. Again circulation, respiration, etc., are not only continuous series processes, but each has a rhythm of its own. Then the countless modifications of compound rhythms, both organic and locomo-

tive, whose effect may be only dimly perceptible, are never absent and their continual presence may produce an unexpected effect. In listening to the tick of a clock, or any continuous sequence of the kind, we divide it into groups. Several report cases where children have inquired why some "ticks" were longer than others. Number is not the result of any one of these units of consciousness, or rhythmical processes, nor of all of them. They are only a part that contribute to the series—idea; but what they especially do is to stamp, as it were, certain numbers of the series, and give them a dominance over the others.

In all of the returns nothing is more common than the preference children and adults give to certain numbers. Again this preference is often unconsciously manifested. Out of 600 returns Dr. Lancaster observed a decided preference for 18. Many will not give their age, or any other number correctly if it fall on certain ones of the series. There are certain numbers of the series we unconsciously avoid thinking in. Odd numbers are generally disliked. Miss D——has a passion for counting everything to find whether it is even or odd, and is displeased if it is found to be odd. I have before me over 100 expressions similar to the following: "Odd numbers always cause a kind of shrinking, as though some obstacle had arisen, while with even numbers comes a satisfied feeling." "The odd numbers seem to me to have something uncanny about them, and to be of less consequence, fullness, and beauty than the even numbers." Mrs. G—— cannot endure having an odd number of anything in the house. Why do merchants price goods $.29, $.47, $.99, etc.? Evidently there is some psychology of number here which is turned to their advantage. We are accustomed, as we say, to think in "round numbers." They appear to be marked "close"; but why should $.47 appear "closer" than $.45? A merchant told me he had sold more of the same article when marked 47 cts. than when marked 45 cts. Cases of dislike for some numbers could be mentioned almost indefinitely where no reason can be observed. Dr. Brown, in relating the incident of the extraordinary precocious girl Marjorie Fleming, gives the following as one of her sayings; "I am now going to tell you the most horrible and wretched plague, the most devilish thing is 8 times 8 and 7 times 7; it is what nature cannot endure." Four is everywhere a favorite number. It is the most important factor in Hindoo arithmetic, all figures and fractions being built upon multiples and fractions of it.[1] Perhaps ten and its multiple stand next, then there is a great variety of choices. I have found nothing to indicate the existence of a number system

[1] Hindoo Arithmetic, Science, Vol. XXV, p. 254.

founded on 6, 7, 8, or 9. Although 12 contains within itself the greatest advantages as a base, it has never been found among savages; notwithstanding civilization has attempted to substitute it for the decimal system, yet it is not likely to prevail. Such is the persistency given to the original system of counting on fingers.

The force of the rhythmical processes may be observed in children's counting, even when counting by 2's, 4's, 5's, etc., which they so much like to do; the rhythm is often very marked, as 5, 10, 15, 20, 25, 30, or 2, 4, 6, 8, 10, 12, etc. Exactly in what order and in what manner these special units of the senses, and rhythmical functions modify the series-idea we do not know, but all observations and experiments tend to show that they do. As I have already pointed out, the compounding of various elements of consciousness in early life, eventually merges into what seems unlike any one of them, yet when such mental activity is analyzed it yields its original component parts.

Let us now consider more fully the naming of the series, several points of which have been mentioned. The naming of the series generally goes in advance of its application to things, and the tendency of modern pedagogy has been to reverse this. This is founded on the false conception that the number concept originates from the observation of things, and the development of number names among savages is sometimes pointed out as proof, but the widely different conditions make such proof of little value. Civilized people have the names to apply to the abstract series, but the savage must invent names or symbols to represent an abstraction that must otherwise remain unexpressed. The fact that the concept is always in advance of the power to name shows that naming is only symbolizing it by means of a corresponding number of things. A few tribes have no word for even one. The Chequitos of Bolivia have none, and use *etama*, meaning alone. Tacanas have only what they borrowed from the Spanish. In the Gudang district only two numerals are used. The original inhabitants of Victoria had no numerals above two, yet they counted, and even recorded the days of the moon. For many years in India "moon" was used for one; "eye," "wing," or "arm," for two; veda, "age," or "ocean," for four, because they considered four oceans; "season," for six, because they recognized six seasons; but here we see the idea of a recurring series of time must have preceded. A tribe in Australia and some of the Malay race, give names to their children in order of their birth, thus forming a number system extending to nine. The terminations are slightly changed for the girls. I have been told of a district

in the U. S. where parents simply number their children according to birth. The moment any series of words is arranged in order in our mind, it becomes a counting machine.[1]

Whewell held that 2 and 2 make 4 is a necessary truth beyond what experience can give. It appears, however, that no such an assumption is necessary, when the concept is fully analyzed. That some number names are among the earliest forms in all languages only strengthens what I have said concerning the very early and in many ways unconscious origin of the series-idea. The use of the names of surrounding objects for numbers among savages gives no evidence that these ideas were derived from *such* objects. Such is but the endeavor of the mind to symbolize ideas gradually evolved as before indicated. The many words which children coin for their own use are not mere babblings, but represent ideas which seek some mode of representation. The adult will frequently fail to see any relation between the name and the object to which it is applied. When a child calls water "guga" and persists in the use of this word for two or three years, it evidently puts into such a word something not conveyed by the general name of the object. For example, a child calls water-melon "bum-bum." Evidently the leading idea conveyed by this word is the thumping common in testing the ripeness of the melon.

In all primitive counting the gesture or sign language comes first. Ah, ah, ah, ah, ah, etc., are natural number words now represented by human machines—striking of clocks, etc. In Livy we read that a nail was driven into the wall of Minerva each year to record its age. The finger method seems to have been the most universal and lasting of all primitive means of counting. Hence the almost universal use of the decimal system, notwithstanding the superior advantages of the duodecimal system, also the prominence given to ten and its multiples. Nearly two-thirds of all number-forms make their first turn at ten, and those that do not almost always do so after reaching the multiples of ten. Sometimes the counting is continued on the toes to twenty and then a man stands for twenty. Most races count to 10, but the exceptions are varied and many. Counting by sticks, pebbles, notches, etc., is second. The Egyptians used simple strokes up to 10, and for the 10's special symbols were used. A simple stroke, pebble, or notch elsewhere can represent 10, 20, or 100. Traces of the same system are found in the system of *tallying* at games, etc. In several instances the numbers from 1 to 9 have been represented by the first letters of the alphabet, the 10's by the next nine letters. Again multiplication found an express-

[1] Tylor's Primitive Culture, Vol. I, p. 258.

ion by dots over the letters somewhat as we represent variations in vowel sounds. a = 1, ȧ = 10, ä = 100 : o = 8, ȯ = 80, etc. This system was used by the Greeks to 10,000. The Chinese never write 245, but 2-100 4-105. A system of bars separating each order of the number was once common in Europe.[1] Concerning the significance given to symbols and the relation of the number concept to intelligence I will have occasion to discuss later.

This is essentially the counting period, and any words that can be arranged into a series furnish all that is necessary. *Counting is fundamental, and counting that is spontaneous, free from sensible observation, and from the strain of reason.* A study of these original methods shows that multiplication was developed out of counting, and not from addition as nearly all text books treat it. Multiplication is counting. When children count by 4's, etc., they accent the same as counting in gymnastics or music. When a child now counts on its fingers it simply reproduces a stage in the growth of the civilization of all nations.

I would emphasize again that during the counting period there is a somewhat spontaneous development of the number series-idea which Preyer has discussed in his Arithmogenesis ; that an immense momentum is given by a systematic series of names ; and that these names are generally first learned and applied to objects later. A lady teacher told me that the Superintendent did not wish the teachers to allow the children to count on their fingers, but she failed to see why counting with horse-chestnuts was any better. Her children could hardly avoid using their fingers in counting other objects yet they followed the series to 100 without hesitation or reference to their fingers. This spontaneous counting period, or naming and following the series, should precede its application to objects.

Mathematical prodigies exemplify this period in the highest degree, and in fact it is to this period of mathematical development that they belong. A true theory or presentation of numbers should co-ordinate all such material, but none of our systematic treatments have considered Number-forms, Individualization, or Dramatization, of numbers, Passion for counting, Mathematical prodigies, etc.; in fact the theories exclude any consideration of these facts as well as all the experimental work set forth in the beginning.

Take from the mathematical prodigy the power to manipulate the series in the four operations of Addition, Subtraction, Multiplication, and Division, and you have nothing worthy of attention. They seldom ever make a practical application of

[1] Number Systems by Conant, PEDAGOGICAL SEMINARY, Vol. II, p. 51.

their power to things or to business, but, carried away with the delight of counting, they remain in an exaggerated development of this mathematical period. In general they, at least, appear stupid, inactive, having little knowledge of, or interest in, any thing except their ability to make rapid combinations in the abstract series. Gauss presents the greatest exception to this statement, yet his power greatly declined. In spite of opportunity for improvement Colburn, Dase, and Mondeux's talents disappeared. Precocity in calculation commonly appears between the age of 3 and 10 years. Not only do mathematical prodigies belong to the counting period, but we find this period prolonged and highly developed in many who have never attracted attention. Many have a passion for counting which they feel compelled to satisfy. In Messrs. Lindley and Partridge's work on Mental Automatisms, 81.3% of 495 cases, have counting habits. Some count anything that appeals to the senses, such as telegraph poles, strokes of a bell, ticks of a clock, etc.; some count by "one, two," "one, two," and so on.[1] Some feel troubled if they fail to count all of the desired objects. Riding on cars seems to be most favorable to counting. Perhaps this is due partly to a rhythmical tendency, to the strong presentation of rapid succession; and to states of revery in which the centers are allowed to respond freely to the various series of changes. Mere abstract following of the names of the series is indulged in with great delight by 131 of the 616 returns now before me, and 23 frequently count themselves to sleep. Again counting is often indulged in unconsciously. Just as I have pointed out in a previous article that there are all degrees of number-forms from the most highly complex and elaborate, even of three dimension, to the simple fact that, at least 90% of all children conceive numbers as taking some direction, and nearly all adults have a similar feeling, or conceive large numbers as being "far away"; so the counting period in which all children find pleasure, and indulge to some degree when symbols are furnished, seems to be quite indefinite; but undoubtedly this period is the genesis of such mental phenomena as just described of which the mathematical prodigy is the highest embodiment.

In my article on the genesis of Number-forms I tried to show that such originate during the period in which the series-idea is being named or the period of spontaneous counting. While the abstract series-idea is being named it is represented by a series of muscular movements as seen in children's counting, but in most cases these muscular movements are suppressed, or partly so at least, before the series is well applied to things, and

[1] PEDAGOGICAL SEMINARY, Vol. V, p. 41.

hence we may expect to find some mental movement corresponding to these muscular movements. The mind struggles to symbolize the series in some way, and on the intellectual side we have some idea of movement given to numbers. This movement may be a mere idea of a vague, indefinite extension in space, or it may become quite definite, complex, fixed, and vivid. It appears then that number-forms have their inception mainly before the series-idea is applied to things, are due to the abstract nature of the series-idea, to suppressed muscular movements and to the long period of development in which the ideas of time, space, and series or number, were so vaguely separated, and of which number-forms stand as a proof.

Much has been said of late about the relation of geometry and numbers. And the tendency is to introduce a kind of "eye-geometry" along with numbers. Even Sylvester said in his address to the British Association: "Whenever I go deep enough I touch a geometrical bottom." If such a relation is shown to exist and has any value it is to be found in the relation of the space concept and the series concept in their nascent state, and the value of such a relation is determined by the degree of dependence yet existing.

II. The Application of the Series to Things and Impressions.

The two steps already considered are the long and gradual formation and development of the series-idea established by an infinite succession of changes produced in consciousness from the beginning of conscious life, and the development of symbols or names representing a series of successions otherwise variously expressed. We have seen that the spontaneity of this period is so great that as soon as any words are arranged in order they are used as a counting machine, and that certain mathematical phenomena that have not, and cannot be co-ordinated in any other treatment, belong here. It next remains to show how these symbols are applied to objects and impressions. Seeing how readily and easily every child learns to count or follow the series even to 100, every teacher and observer must be convinced that its application is the most conscious and difficult step yet reached.

At first the individual thing stands for the number. Two hundred and ninety-two cases are given where children count objects; as four people, and although all except one may have disappeared, yet if this be the last named it is still called four. In counting chairs, etc., no collection is recognized for sometime. Dogs, chickens, etc., are often counted, each standing for a number and not as a part of a quantity, just as the case already cited where the boy recognized four dogs, Tip as

"naught," etc. Many cases of this kind occur in the early counting of children and among savages. Without doubt some of the strange psychological phenomena sometimes called dramatization and individualization of numbers, in which the numbers, sometimes to 20 or more, are invariably associated with, and thought of, as some object or person, finds a satisfactory explanation at this point. Four is a fat duck, 7 a tall man, 8 a pale faced woman, etc. P——. Five is a pig tail, 4 a box, 7 a tall woman, 9 a lazy man, 11 a pair of match horses. S——. I always thought of 7 as my crippled father (one legged), and 8 as my grandmother, and 9 as my tall grandfather. Now it is very natural that the child that called his neighbor's dogs naught, one, two, three, if this association be kept up, will later modify the objects associated with these numbers in accordance with the ease or difficulty in using these numbers. Three may become a mean troublesome dog; two a good puppy trying to make things even; naught an indifferent, easy-going fellow. While I have no direct evidence of this, yet it seems a very natural step in association and a plausible explanation. It further appears that the object is dropped later, or an association based only on some operation in the use of numbers arises. Two is simply a good little figure, 7 is a bad number, 3 is mean and cheats others, 11 is a happy, go-lucky individual, 13 is mean like 3; 25 is a square, round-faced fellow, etc. Then we have a few cases where numbers seem to carry on a continual combat for certain places: thus, 7 tries to get into 14, but is crowded out by 2; it then makes an effort for 28 or 35, but being crowded out, after much difficulty gets into 49, and so on with the various numbers. F——. Four seems disagreeable and devilish, because it turns its back upon every number into which it is put. A child of 6 yrs. says 9 is cranky and you cannot divide it into 2's at all. B——. The figure 4 always seemed so staid and firm to me, until I was told by a teacher that one of his pupils said that she always made the figure 4 to waltz time, and ever since then it has stood apart claiming an air of its own.

While such exceptional cases may seem entirely beyond the explanation given for the simpler forms, yet it is better to seek their explanation in some association in early steps in the development of number than to treat such as entirely outside the ordinary laws of association.

In the application of the series to things is where the child first encounters much difficulty, and this is much increased because the teacher not apprehending the full importance of this step tries to hurry the child over this point entirely too rapidly. It is here that we meet with so many systems and devices for teaching numbers.

It seems necessary, then, that we should first consider the quan-

titative ratial-idea of numbers, held by Dewey & McLellan, Graham, Speer, and Lefevre, to which reference has already been made. This is entirely different from the series-idea which has so far been under consideration. It is a reasoning process to which the series-idea is applied. The eye-span and ear-span, a summary of which has been given, in so far as they are purely such, are but quantitative relations of groups. In the case of the eye-span where we find the purest, if not the only, examples, in its last analysis, it is the simple recognition of a form. Many cases are reported where animals seem to have a high sense of numbers, such as various fowls that recognize the number of eggs, animals that recognize the number of young, or pigs, sometimes exhibited in shows, capable of playing cards. When a boy, I remember, a turkey hen that always quit her nest if a single egg was removed, even when the nest contained 7 or 8 ; but after sometime I found she could be thoroughly deceived by removing 3 and putting in 4 hen eggs. It was only necessary to make the general bulk or form appear the same. Such will be found to be the case with most of such examples. The card-playing pig simply recognizes a form, as may be observed by any one who will analyze their own mental operation in playing a game of cards. In order to make clearer the difference between the series-idea and this quantitative ratial-idea, I wish to state some observations made on children. In one of the large kindergartens I observed the children giving the combinations of eight. The lesson was conducted with 8 two-inch cubes by separating them into various combinations. The results were given by the children as if it were an instantaneous recognition of so many numbers. I then asked if other objects could be obtained, and tests were made with various other larger and smaller forms, and objects taken from my pockets ; but in every test it was evident that counting was the only guide if any accuracy was reached. Such tests were applied in four different schools to 65 children learning the combinations of 10. The result was such as to make it evident that in most cases the combinations and relations so readily recognized were more a matter of form than of number, and that individual enumeration was resorted to whenever any doubt existed. Again the same thing was found even in a more marked degree when tests were made by presenting dots to the eye. One teacher presented to her children five dots in nine different arrangements and in every case they were obliged to learn the form before the number could be recognized as five without counting. The same thing is found wherever such tests are made. One teacher states that after teaching the numbers for sometime by dots arranged on cards, she accidentally put some of the numbers on the board in a different arrangement, and

was astonished to find a hesitancy in recognizing them. She then for the first time realized that she had been teaching form rather than number. It is fully believed that a close analysis will show many of the above results on the eye-span and ear-span to be only the recognition of form, or that the result is obtained by rapid counting and grouping, which, occurring so often and so rapidly, gives no conscious mental activity unless special attention is paid to the operation. There are many cases where a judgment is immediately given, apparently without any reflection, and such have been counted *instinctive;* but close attention to such mental states reveals even to the individual the steps by which such a judgment was formed.

Mr. Speer's Primary Arithmetic is founded on the assumption that the end of arithmetic teaching is to induce judgments of relative magnitudes. It is rather curious how much quantitative judgments are insisted upon. The Dewey and McLellan idea is very much emphasized, and to the entire exclusion of any other side. Here we have a logical process of reasoning insisted upon to which the series-idea is applied. "Reasoning in arithmetic establishes equality of relations, reasoning in any subject equality or likeness of relations "[1] By what authority can we make the science of numbers co-extensive with all reasoning? Number in its genesis is independent of any, or all, quantity, and the science of numbers is essentially the relation of one number in the series-idea to another. That some form of the series-idea may be applied to all, or at least, most processes of reasoning, I admit, but that is quite a different thing.

Dewey and McLellan, with those already mentioned, holding the same ratial-idea, fail to see that there are two sides to the application of the series to things, the logical analysis to which the series is applied and a more general comprehension and application of the series-idea. We are told that, "It requires considerable power of intellectual abstraction even to count three,"[2] that "the manifestation of the conscious tendency in a child to count coincides then with the awakening in his mind of the conscious power of abstraction and generalization. This also indicates discrimination and relation."[3] The truth of such statements can be maintained only by giving counting a false or philosophic meaning not sustained by any of the facts connected with counting. It is a capital error leading to the worst pedagogical blunder to suppose that abstraction and generalization go hand in hand with counting, or to suppose that

[1] Primary Arithmetic, p. 35.
[2] Dewey and McLellan's Psychology of Number, p. 25.
[3] Dewey and McLellan's Psychology of Number, p. 27.

number has any such meaning. Counting chairs, tallying by beats, etc., are no signs of abstraction and generalization, neither is the power to manipulate the series in the four fundamental relations any sign of such. I have found many children whose number sense was very highly developed, yet very inferior to other children in the power of abstraction and generalization. If this were true, the general intelligence of savage races should go hand in hand with the development of their number concept, but the exceptions are so many and so varied that no one can draw any such a conclusion. Take from the mathematical prodigy the power to *count* and manipulate the relations of the series, and as a rule you have little of any kind of intelligence remaining. They are noted for their general stupidity in other lines. Every one who has lived among the negroes knows how much their number concept is in advance of their general intelligence. They are generally unable to read or write, or to form any abstraction or generalization, but never unable to count and in many cases to perform astonishing calculations. Take Thomas Fuller, the African slave, who died at the age of 80, never having learned to read nor write, and was of very low intelligence, yet his arithmetical calculations are among the wonders of mental phenomena. This philosophical theory is not wide enough to cover all the facts. The ratial-idea is but a part of the philosophy of number and takes in but one part of the application of the series-idea.

In what does the comparison of two quantities differ from the comparison of two leaves? "Quantity is limited quality, and there is no quantity save where there is certain qualitative whole or limitation."[1] To carry out their quantitative ratial-idea, and make number the "rational process" desired is to identify number with all reason. The application of the series-idea to the logical processes of reason no more makes them identical than the giving of motion to a ball makes the ball and the motion identical. Some maintain that mathematical reasoning is different from other reasoning; but there is still a wide difference between the reasoning involved in the fundamental operations with the number-series, and mathematics taken as a whole. This philosophy not only ignores any such difference, but any other that might exist. "*Reasoning in arithmetic establishes equality of relations, reasoning in any subject* equality or likeness of relations." It is true that "all relation is a result of comparison," and we can hardly conceive reasoning that does not involve comparison in some way, and even an application of the series-idea, either definitely expressed or more or less distinctly understood. When a child asserts two leaves to be

[1] Psychology of Number, p. 57.

alike or unlike there may be involved a geometrical comparison and a comparison of the intensity of color; but there is no expression of such on the part of the child, and it is greatly extending the idea of number to call it arithmetic. Even granting there is no strict line of demarcation either between reasoning in general and mathematical reasoning, or between general mathematical reasoning and the simple operations with numbers; yet there are certain marked stages of development and application that no one will think of identifying.

This application of numbers is the latest and most difficult step, and no attempt should be made to push it on the child before the proper time. The most general use of the series does not involve this comprehension and application of numbers. If drill, for the logical reason be the aim, such an application of the series at the proper age is, without doubt, of utmost value; but having seen an advocate of the ratial-idea labor long and hard with no result but confusion on the part of the pupils, I am convinced that it is a step demanding considerable abstraction and generalization, and of a nature not found in the more general or common applications of the series, such as made in ordinary counting and calculation.

III. Results of Some Original Investigation.[1]

This part of the subject will include (1) the examination of 616 returns on the syllabus on Number and Mathematics, (2) the result of 2,043 papers on numbers and arithmetic, collected from the first to the ninth grade inclusive.

The following syllabus was issued:

NUMBER AND MATHEMATICS.

I. Psychological and Anthropological.

(a) State cases where animals, or children who could not count, have distinguished, *more or less*, objects, as eggs, young, toys, etc. How fine was this discrimination, how shown, and other details?

(b) Describe games of instantaneous guessing of the number of objects in a group, noises in a series, inches, feet or rods in a given distance, surfaces, angles, etc.

(c) Describe cases of tallying by beats or counters, before counting, or before number names are known.

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[1] See also Genesis of Number Forms, *American Journal of Psychology*, Vol. VIII, pp. 506–527.

(d) How do children learn number names, and how use them, what changes of order, errors in learning to count things; does the object series or the number series get ahead? Describe fully cases where counting became a passion, and everything must be counted, also cases of school children who use fingers, move toes, nod, etc., or use other counters.

(e) Errors and order in learning figures, making or applying them. Do the figure forms have any moral or personal character, as: 8 looks happy, 7 cross, 4 solid, etc.? Report fully when such associations exist. How different do Arabic and Roman numeral forms seem?

(f) Cases of number forms, *e. g.*, the first 12 numbers being habitually associated with a dial or clock face, the first ten on a line, straight or curved, systems of dots, colors, etc. Do odd seem to you different from even numbers? Draw any number forms. How do you arrange days of the week or month, the musical scale?

(g) Cases of "eye geometry," or automatic puzzling over patterns of carpet, wall paper, bricks on sidewalks, strong fondness for tracing the forms of decorative ornamentation, spontaneous drawing of such patterns or development of them in the use of kindergarten material.

(h) Cases of children exceptionally forward in or fond of mathematics and those exceptionally backward. Describe any physical or mental peculiarities of such children, their other tastes and aversions, and account for this peculiarity. Especially, if you have a prodigy, try to find out just *how* (by what process) each cardinal operation is done; the same of dullards.

(i) Describe any rare case of pupils who associate number processes with personal acts or dispositions, as *e. g.*, four is peaceable, and dwells tranquilly with eight, but with seven it feels and acts out enmity, etc.

(j) Ask children of each grade what part of the year's mathematics they like best and least, and why, letting those of upper grammar and high school grades write out their answers.

(k) What figures or numbers give you, as well as your pupils, most trouble in adding or multiplying?

II. Pedagogical. A. Elementary.

(a) Please state how you would teach beginners. Describe your special methods with any phase of the work. Special drills.

(b) What mistakes are most common in—1, notation; 2, numeration; 3, adding (oral and mental); 4, subtracting; 5, multiplying; 6, division; are these more or less if special accuracy is attempted?

(c) If you have tried (1) the Grube method, state its chief

merit and defect, (2) the same of Colburn, or much *mental* arithmetic.

(d) When would you begin fractions, and briefly outline your method of (1) beginning, and (2) of teaching common denominator, etc.

(e) Should more intensive methods, a larger or less proportion of time, more mechanical drill of both memory and slate, and less rules and explanations be advised?

(f) Or is this pure form work, abstract and obsolete, and far from the pupil's experience, the traditional application to *values* too commercializing, and should the number relations grow out of observation, facts in zoölogy, botany, physics, astronomy, etc.?

(g) What illustrative or other apparatus would you use for each stage thus far? 1, How long should, *e. g.*, four be illustrated by four girls, tops, apples, etc., before the child understands that it can apply to anything? Would you use any form of abacus, or Russian counters, and if so what, how and how long? Value of associating, *e. g.*, 1, with unicorn; 2, with an ox; 3, with a trefoil; 4, with a quadruped; 5, with a star; 6, an insect, etc.; also value of jointed figure, *e. g.*, 8 joints in the figure 8, etc. Value of toy money, divided spheres, jointed rods, etc., for fractions. Do the marketing, shopping or trading stories, as a setting or motive for the pure number relations, help or hinder; and how, why, instances? Do you know any rhymes, songs, puzzles, or games or any other device that may help some? What charts, or diagrams, or blackboard pictures are helpful?

B. Higher Arithmetic.

(a) Of 1, proportion; 2, percentage; 3, roots and powers; which should come first and which last, and briefly, *how would you begin and proceed with each?*

(b) What should be the place of weights, measures, moneys?

(c) Of the business application of the science of pure number relations, as interest and partial payments, exchange and bills, commission and brokerage, banking, taxes, bonds, annuities, or of their application to science, as in mensuration, surveying, longitude and time, geography, astronomy, physics, etc. Which is most important? Which logically first and last, and how would you teach each?

(d) What apparatus would you advise for upper grammar and high school mathematics, as slates, globes, drawing instruments with verniers, cube root blocks, theodolite, weights and measures, graphic methods and charts, etc., etc.

(e) Name the best text book or books, in your judgment, with the ground of your preference.

C. GEOMETRY AND ALGEBRA, ETC.

(a) At what point in arithmetic should geometry be begun and how, and how co-ordinated with arithmetic and algebra?

(b) Name best text book and method for beginners. How far, and if at all how should geometry be based—measurement, drawing, or the data of astronomy or physics?

(c) At what point should algebra begin and how?

(d) Should it be taught abstractly and formally at first or concretely, and if the latter, on what basis? Name best method and text books for beginners.

(e) At what stage of progress, or at what grade or age, would you begin trigonometry? Name best method and text book. How would you connect it with previous mathematical work, and what practical work, observation or experience would you make use of?

(f) At what stage of progress, grade and age would you begin calculus and how? Name best method and text book for beginners. How would you connect this work with (a) previous work, and (b) informal observation and experience?

Something over 800 returns were received, but nearly 200 were found of little value in any way. Nearly all of the returns relate only to the first part of the syllabus, however, about 100 have something to say on the second part, and 13 papers treat it extensively.

Of the 616 reporting on the first part, 235 are men, 319 women, 62 do not designate sex. No further attention is given to sex, since there is no difference of any note in the returns. Seventy-two per cent. are teachers; forty per cent. have taught over five years.

Animals, or Children who could not Count, Distinguished, More or Less, Objects, etc. One hundred and thirty-five cases were reported for children; 170 for animals, the nature of which may be seen from the following: G——. A cat with 3 kittens will miss 1 even before they are a day old. R——. Bob used to bring 5 cows; if 1 were missing, would, of his own accord, go back after it. F——. Our guinea always leaves her nest if a single egg is removed. Have tried her time and time again. D——. I have a dog that can count 5. He will bark once if you hold out 1 finger, twice for 2, and so on to 5; he will bark for sticks in the same manner. M——. Bruce, our dog, used to bring the hogs out of the meadow. When in the lot, he would look them over, and, if any were missing, would go back. M——. Thomas, 32, cannot count above 10, yet he can

split rails by the hundred and know just how much he has made. H——. I knew a boy, 4, who could play casino before he could count 10. He seemed to know the value of the cards by the arrangement of the spots. C——. Willie, only 3, had 7 blocks with which he played. I took away 2; he observed no difference until he attempted to put them in the usual form. He then cried, saying some one had taken his block; returning 1 did not satisfy him.

These examples are sufficient to make clear the general replies to this question. It will be seen at once that the difficulty encountered here is to determine when it is *form* and when it is *number* that is recognized. That animals have some number sense both as a succession and as a relation between magnitudes cannot well be denied, but, as I have already pointed out, much that passes as such is only the recognition of an individual form; and this is certainly true in nine-tenths of the cases given for both animals and children.

Games of Instantaneous Guessing of the Number of Objects in a Group, Noises in a Series, etc. Two hundred and twenty-six cases are given, and 73 different games. Much under this heading bears a close relation to some of the returns on Mental Automatisms,[1] and in some respects to Dr. Lindley's Puzzle Interest. However, he finds guess-games and riddle-making to begin about 3, and culminate from 5 to 8.[2] Only 59 in my returns mention the age of guess-games, and it is generally placed between 6 and 10.

Of Tallying by Beats before Number Names are learned, 91 cases are given. H——. Fred will stand by the window and tally as the rain-drops fall. C——. Eddie, only 2, often repeats the strokes of the clock. F——. When I was about 3 I tapped my finger as the rain-drops fell. Also sorted a collection of pictures, making a mark for each one put aside. H——. B., 4, keeps tally by closing one finger as the clock strikes, etc., also by shaking his head when the piano is played. D——. F., 3, was playing "farm;" every now and then he put a stick up the water pipe. E. asked him why he did this. He said: "They will tell me how many times I go to mill." H——. Children follow the series in various ways, sometime before the names are given. F——. A boy, 5, will arrange piles of sticks of different sizes, and then lay aside one larger stick for each of the different piles.

On Learning Number Names, 341 give a definite answer; 314 say that children learn them by rote as abstract words; 27,

[1] Lindley and Partridge, PEDAGOGICAL SEMINARY, Vol. V.

[2] A Study of Puzzles, *American Journal of Psychology*, Vol. VIII, p. 450.

from objects. This is one of the most important topics discussed in the returns. Several cases have already been given in the first part of this article, and only a few need be added here. P——. Children learn number names by imitation or by hearing them used, sometime before they know how to apply them. D——. C. could count 100 long before she could recognize 6 or even 4 objects. M——. They learn number names by hearing them and use them promiscuously, calling objects by number names. It is astonishing how readily, and how many children learn number names even to 100 while they have a very limited knowledge of their application.

The Application of the Series formed another very interesting topic to which there were 329 answers; 292 may be classed as cases where they apply them indiscriminately; 37 to objects. Some of the 37 do not seem to understand what is desired. They speak of children applying them to objects, and then state that children designate objects according to their order in the series wherever they may be placed. Practically all substantiate the fact that children apply number names indiscriminately or promiscuously. In this connection are found some of the most important facts for pedagogical treatment or teaching of numbers. R——. C., 2, always uses 2 for everything, if he sees 5 birds he will say "2." H——. When L. was 3 he would press the piano keys and say: "1 key, 4 keys, 8 keys," etc. I have often observed him counting to himself, saying, "1, 5, 8, 10, 20, 3, 9," etc. S——. Sarah will often put blocks in a pile by 2's and count only by ones. M——. Sometimes I have my children count objects they can handle, and, if they have any idea of how many to expect, when the series number begins to get ahead, they will put over two or more at a time.

I am indebted to Miss Shinn for a very accurate, extensive, and valuable record on the observation of a child from the 8th month to the 6th year, a very brief digest of which is presented: First indication of number, observing things in pairs at 8 months; at 16 had an inclination to enumerate similar things, by successively touching them, counted her fingers, but not in correct order; at 17 taking nuts out of a box, etc., one by one, time and time again; at 19 delighted to transfer objects one by one; number above duality was not conceived; "more" has been used, can count, but has no idea of quantity above two. Taking out cards she would say: "De wu" each time, apparently understanding it. At 20 months she understood "all" of any objects. The idea of succession of units was evidently manifested in various ways. At 22 months she tried to count 5; her uncle counted his fingers, she held up hers and counted correctly to 5. Two days later one finger was held before her, she said, "one;" two, she said "three." Being asked to look again,

she said: "four," and went mechanically through the list while only 2 were presented. For some time about the 25th month she would call more than 2 "two-three," could count to 10, but did not know 3. At 26 could count without help, if not allowed to count for both taking up and laying down; yet in the 28 month sometimes 2 appeared to mean only more than one. Was proud of her first independent counting, often chanted the numbers; two days later, all alone, trying to count beyond 10, she said 11, 12, 14, 18, 15, 40; do not know how she picked it up. At 35 she could add the combinations to 6, but only subtract one; counted to 19, stumbling on 7 and 17; also counted by repeating names at random. At 4½ years she counted to 50. Four months later Miss Shinn began lessons in number with objects, she cared little for this, and apparently learned little. Her mother, taking her, dropped objects and made it frankly a lesson with a demand on the imagination. The child responded better to this and soon came rapidly into an understanding of numbers. She reduces all to counting, says she does it in her head. Though concrete terms are used, she does not think in such. At 5 years 8 months, could count 1,000. The above is digested from 55 pages.[1]

Change of Order of Number Names. One hundred and seventeen such cases were tabulated. A close analysis was made to ascertain if any order was generally hit upon, but such was not found except that 7, 9, 11, and 13 are omitted much more frequently than any other numbers. Eighty-nine, out of the 117 cases reported, omit or misplace one or more of these numbers. Thirteen count almost entirely by using the even numbers, but no general rule prevails. This disregard for order shows that the child cares only for the series of *successions*, and that any suitable words will afford it a counting machine.

Does the Number Series, or Object Series Get Ahead? This question was answered by 181; of whom 151 say the number series; 30, the object series. The facts revealed under this head are of the utmost significance. Sufficient cases have been cited in previous parts of the article. In the individual tests made on 66 children, I found that children in the model school and even in the first grade counted with considerable difficulty if they were required to keep the object and the number series equal. It becomes quite a slow process. Mr. S. told me that his children would not get the number series ahead if he moved the objects over very slowly. The fact that children can hardly go fast enough when following the series only, seems strange, but simply indicates that the number series and its application to things are quite different.

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[1] See page 232.

A Passion for Counting is strongly emphasized by 131. By 43 it was carried over into adult life; in 88 it was most extreme between 7 and 10, disappearing soon thereafter; 57 first had a passion for following the abstract series, later for counting things. The culmination of this passion between 7 and 10 indicates that it is the period when the number series is applied to the object series. Such may be designated as the counting period which in some is prolonged and highly developed. Dr. Badanes does not specify any age for this counting period, but we infer from his suggestions on teaching numbers that it falls within this period.[1] B——. H., when only 5, could really count 1,000 by 100's, and did count 300 by saying 101, 102, 103, etc. F——. M. could count 100 rapidly when 3. Counted everything she saw when 7 and 8, and often counted time by seconds when alone. T——. Mary, at 8, would stop to count the shutters on houses, count her steps; everything had to be counted or she was not satisfied. One night went to bed very unhappy because she could not count all the stars.

Counting on Fingers, by Movement of Toes, Head, etc., is noted by 260. The reader is referred to what has been given on movements in counting.[2] F——. In a school of 50 children I found that every one counted on their fingers, most of them on the sly, but some unconsciously. G——. I find that when children are forbidden to use their fingers, they will resort to some other movement, tapping the foot, moving the toe, head, or arm, even to any muscular contraction. In some late experiments on counting, involving considerable complexity, Mr. Bohannon found that subjects could not count without making some movement. The motor element plays a large part in nearly all thinking; but any one giving attention to any series of succession will find this tendency stronger than in most other mental activity. The rhythmic nature is perhaps more effective.

Errors in Making Figures. One hundred and seventy-two errors are reported; 43 make 3 backward; 52, 9 and 6; 31 confuse 3 and 5; 28, 9 and 6; 18 are miscellaneous. These may furnish minor points of interest for the teacher.

Individualization or Dramatization of Numbers. Only 35 cases are given. C——. I always thought of 1 as tall and thin, 3 as cranky, 9 graceful, 7 stubborn. D——. When a child, numbers were always some real person to me; 3 a well known carpenter, 4 a heavy woman, 7 a lawyer always prosecuting 9, etc. How this came to be I do not know, and cannot remem-

[1] Falsity of the Grube Method.
[2] See page 234.

ber when they did not appear so in childhood, even now I am not entirely free from it.

How Different do Arabic and Roman Numerals seem? brought forth some rather peculiar answers. Only 4 say they like the Roman numerals; 173 dislike them because they are "stiff," "dignified," "reserved," "vain," "used for state occasions," etc.; 69 detest them because they are of "no use," and cannot see why letters must be used to express numbers. E——. I always thought them grand and stately, and took extra care to make them. G——. Roman numerals seem like something foreign, always thought of Roman soldiers and avoided them when I could. A——. Thought they were meddlesome because they are both letters and numbers. D——. Dignified, always associated them with kings. H——. Always had a great significance to me as I had seen them in the Bible, dreaded to use them. Do not like them now except on the clock. H——. Arabic common; Roman numerals something extraordinary, so brave looking. It would be interesting to relate several more of these returns; the clearness and earnestness with which every one is stated bear conviction that here are some psychological associations, somewhat common, but perhaps unsuspected. They certainly give valuable hints on the laws of association which, if not valuable in themselves, throw light on certain phenomena that seem not to come under any laws of association, such as we have already mentioned, etc.

"*Eye-Geometry*" is indulged in by 150. All of this has been so well worked up in Mental Automatisms to which reference has been made that I deem it unnecessary to present the matter here.

Accounts of 19 children unusually bright in mathematics, and somewhat dull in other branches, are given; and 6 who are quite stupid in mathematics. One boy, 9, can read and write, but cannot learn to count.

The Likes and Dislikes in Mathematics are difficult to classify. Seventeen different parts are mentioned as being liked; 21 disliked. Three hundred and fifty-four mention some like or dislike. Since the manner of teaching, etc., modify one's taste so much, I shall cite only the points that seem to be free from this and of most interest. Fifty-five like Interest, none dislike it; while 48 dislike Stocks and Bonds, 2 express a liking for such. Mensuration is liked by 25, disliked by 13; only 1 reporting "eye-geometry" dislikes mensuration; 17 of those who report such like it. The G. C. D. and L. C. M. is detested by 23; 19 like Mechanical work; 12 detest problems; 14 girls and 9 boys hate the whole of arithmetic. Geometry is liked by 36, disliked by 1; Algebra is liked by 34, disliked by 1; but these nearly all come from a single school. Such are the points of

any special interest. The prevailing reason for likes and dislikes was "useful," or "no use."

Besides the above, 260 papers from the 4th and 5th grades, in which children state their likes and dislikes, have been examined. In the 4th grade 38, out of 124, dislike Long Division; 51, G. C. D.; 22, Concrete Problems; 47, Fractions. Sixty-nine like Addition and Multiplication; 62, the Mechanical; 20, Decimals. In the 5th grade 35, out of 136, dislike G. C. D.; 14, Percentage; 19, Fractions; 16, Denominate Numbers. Sixty-two like Interest; 28, Decimals; 18, the whole of Arithmetic.

What Numbers Give Most Trouble in Adding or Multiplying? There were 440 returns received; 157 give 7 and 9; 88, 7 and 8; 34, 6 and 7; 42, 7 only; 18, 9 only; 26, 3, 6 and 8. The others were miscellaneous. Seven is found in 327 cases, 9 in 204. Five say 9 is easy, always 1 less than 10.[1]

From the above returns it appears that we may justly conclude that there is a period of number development that precedes conscious counting, quite distinct in children, if not in animals; that tallying by beats, sticks, etc., mark the spontaneous development of the series-idea; that number names are surely learned abstractly, or by rote; that counting first proceeds by following the series names without any regard for the order of the name; that number names are first applied promiscuously to objects in which the *number represents the order of the object in the series and not a collection of objects;* that guess-games and a passion for counting have a considerable place in child-life from 6 to 10, which is, to a great extent, a period of spontaneous counting; that children in their first application of the series to things run the series ahead; that a *muscular movement of some kind is almost unavoidable with children when counting, and not uncommon among adults;* that personalization of numbers may originate in the early application of the number series to things in which the person or thing stands for 4, etc; that Roman numerals are generally disliked; that a spontaneous habit of forming geometrical figures exists among many; that likes and dislikes of subjects in arithmetic depend in the main, upon the probable degree of usefulness in life, but

[1] On examining the U. S. Census for 1880, it is found that those who guessed at their age, etc., have a decided preference for the fives and tens, also for even numbers. Analysis of ages from 28 to 42 for Ala., Mich., and U. S. as a whole, shows the most striking results. Those giving their age at 30 and 31, being about as 4 to 1 for Ala., as 5 to 2 for U. S.; at 40 and 41, as 5 to 1 for Ala., as 13 to 6 for Mich., as 3 to 1 for U. S.; at 47 and 48, as 4 to 5 for Ala., as 6 to 7 for Mich., as 4 to 5 for U. S., etc.[1] In various curves and diagrams the effect of even numbers is very discernible.

[1] *Favorite Numbers.* Scientific American Supplement, March, 1889.

the word "useful" is not explained by those answering, and this is subject to various modifications of teaching, age, position, etc.

Of the 100 returns bearing on second part of the syllabus, 22 say that mistakes are most common in subtraction; 9 in multiplication (being more of it); 14 say mistakes are more common in oral than in written work; 38, written work.

Twenty know nothing of the Grube Method; 17 have used it to advantage; 28 think that fractions should come earlier; more mechanical drill is urged by 18, and less of it by 28. A., a graduate of Yale, says: "I was taught the numbers as a drill in memory. It was an exercise in which every one wished to excel. We recited our tables until our work with small numbers became almost a reflex action; *never* had any trouble using them." C——. "Drill element is good, but it destroys the higher comprehension of numbers so necessary for development."

Forty-eight think that in the country children's number sense is so developed on entering school that objects are necessary only incidentally; 29 think there is much danger of carrying the objective illustration too far. M. writes that association is best acquired when it is casual and can be dwelt upon until the child will think "5" without thinking "star." Proportion is placed before percentage by 24, after by 56; roots are placed after proportion by 34; last, or with mensuration, by 62. Doubtless much of this depends upon former teaching, books used, etc.

Teachers in different places and schools were requested to give review exercises covering their regular work in arithmetic and to collect the papers for examination. I have examined 2,043 such papers, with the following results:

Grade.	No. of Papers.	No. of operations or problems.	Total mistakes.	Confusion of operations.	Mistakes in operation.	Mistakes. in principle.
I.	405	6264	354	89		
II.	224	3815	694	137		
III.	550	11976	538	145	66	11
IV.	95	272	31	27		
	1274	22327	1618	398		
V.	139	1604	818		15	11
VI.	140	847	297		47	9
VII.	130	1357	359		21	13
VIII.	380	2251	890			
	2043	28386	3982	398	149	44

By confusion of processes is meant that the child's work would have been correct in some other operation as 4+4=16, or 7—

2=9. A large part of the work was not of such a nature as to give this information. Of the 1,618 mistakes made in the first four grades, 409 were of such a nature that it was impossible to tell whether they occurred from a confusion of processes or otherwise. Excluding these, about 33⅓% of all mistakes in these grades are results of the confusion of processes. This confusion appears greatest in 3rd grade, but this is due to the fact that the 409 mistakes belong chiefly to the 1st and 2nd grades. More than 540 papers involved problems, and an effort was made to classify the mistakes on these according to operation and principle. Teachers are fairly well convinced that mistakes in the four operations greatly dominate, even in the 7th and 8th grades. It is very evident that subtraction is more difficult than addition. A teacher of 19 years' experience writes: "Subtraction is the most fruitful source of mistakes even to the 6th grade."

Two hundred and eighty-three papers on multiplication, involving 1,095 problems or multiplications, the majority of which contained three figures in multiplier and four in multiplicand, collected from the 9th grade, are of some interest. Total number of mistakes in these are 691; 186 were made in multiplying by 9; 195, by 8; 199, by 7; 57, by 6; 9, by 5; 15, by 4; 3, by 2. There are certainly some indications that Mr. Walker's charge has a general application. It will be observed in the table that the total mistakes, in all grades, exceed the number of papers by more than one-half. Considerable material in other lines remains to be worked up.

IV. The Application of Numbers to Arithmetic.

Under this heading will be considered, (1) A brief digest of some books and articles on arithmetic, (2) Suggestions on textbook making, (3) The result of the examination of 166 textbooks on primary and elementary mathematics.

Brevity may prevent a clear statement of a writer's view; in many cases only a few of the leading points can be mentioned. No classification will be attempted. Reference has already been made to Dewey and McLellan's Psychology of Number, in which the Hegelian idea of number as ratio and quantity as limited quality dominates. Number is developed from measurement and measurement arises from the adjustment of activity. The ability to count is made to coincide with the power of abstraction and generalization, requiring ability to hold the mind from being absorbed in the delights of seeing, hearing, etc. Counting trees, etc., can only give the idea of imperfect number since they are not conceived as a vague whole and broken up into parts of *equal units*. Two false methods of teaching numbers are in use, the one teaching numbers as a set of sym-

bols, the other, as a direct property of objects. Neither, they say, takes into account the fact that number arises in and through the activity of mind in dealing with objects. A severe attack is made upon the Grube Method because unity is taken as one thing. In the measuring method unity may be 12, a month, etc. The practical part everywhere shows evidence of an effort to join it to the theoretical, but the difficulty is likewise evident. Much of the practical part is common, and is found in use. The factor idea has its genesis in multiplication, multiplication in addition, division in subtraction; but neither is identical with the other.

Lefevre's Number and its Algebra has as its bottom principle the *Continuity of Number and Mathematics*. Number is *continuous*. Algebra was slowly developed out of the investigation of numbers, and geometry cannot apparently proceed without arithmetic. There is a more primary and essential connection than Euclid made in his Fifth Book. All definitions should be tentative and capable of expansion. The principle of *continuity* makes negatives, zeros, infinities, fractions, and all numbers alike. "Primary number is a discreet magnitude, and the product of rational processes." That ten is not a convenient base, that a distinction should be made between pure and applied arithmetic, that all multiplication is not repeated addition (*i. e.*, $\sqrt{2} \times \sqrt{3} = \sqrt{6}$), that long division should be taught first and abbreviated as the mind becomes able, such are but a few of the practical points considered.

Schubert's article on Monism in Arithmetic bears on the same line of oneness in mathematics, but is not so clear, deducing the laws of addition and multiplication from algebraic formulas. The substance of Schubert's article on Notion and Definition of Number has already been cited. Speer's and Graham's arithmetics have been previously mentioned.

The Committee of Fifteen gives mathematics the second place of all studies. So long as individual differences which are qualitative in so far as they distinguish one part from another are considered, objects cannot be counted. When counted, the distinctions are dropped out of sight as indifferent. Counting is the fundamental operation, all others are devices for speeding this one. Fractions are much more complex than simple numbers, involving three steps instead of one, and comparison or ratio. This is the cause of the child's embarrassment on entering fractions and operations that imply ratio. The pupil descends to the simple and returns to the complex numbers. Decimals are still more difficult, and roots a still further step in ratio. It is an advance to be able to separate or analyze the concrete, whole impression, and consider the quantity apart by itself. But if arrested mental growth takes place here, the re-

sult is deplorable. Without doubt such an arrest may take place by the too exclusive training in recognizing numerical relations.

The Committee of Ten recommend that the ordinary course in arithmetic should begin about the sixth year and be completed about the thirteenth; that the course should be abridged by omitting subjects that perplex and exhaust without giving any real mental discipline (that is the practical affords the best means of discipline); that the method of teaching should be thoroughly objective, and, as far as possible, inductive; that the text-book should be subordinated to the living teacher; that quickness and accuracy should be considered of great importance; that child geometry should begin in the kindergarten, and systematic instruction in geometry about the age of ten. The Conference declares that most of the improvements suggested on arithmetic "can be summed up under the two heads of giving the teaching a more concrete *form*, and paying more attention to facility and correctness in work."

Mrs. Hornbrook's Laboratory Method proceeds upon the plan of individual research on different subjects, and she is present during the work to "suggest." Those using this method lay stress on the flexibility of their plan and the previously unperceived differences found among many pupils. A class of 42 in geometry takes a few weeks in concrete work, only a part of the recitation being devoted to class work. The class is divided and inspectors are appointed over each division. She claims that it is related to "self-education," that it enables the mentally acute to advance rapidly, gives the dull ones time, and that the sympathy between pupils and teacher is strengthened. Mrs. Hornbrook has also given us a work on Concrete Geometry in which she wishes every beginning in lines, angles, squares, cubes, etc., to be made purely concrete, and to be worked out by the pupils. It is intended for grammar schools.

A Class in Geometry by Geo. Iles is a small pamphlet presenting the concrete aspect, and would begin geometry by observation; a house-lot and two fields tell us much geometry. *Go from facts to law.* The work starts off well, but it is difficult to see geometry in all that is said.

Alex. Hogg writes an article, More Geometry and Less Arithmetic, in which he maintains that arithmetic should not precede, but begin with, geometry. Fractions cannot be taught without geometry, and algebra is but a form of arithmetic, somewhat a connecting link between arithmetic and geometry.

In Jackman's treatment of the Relation of Arithmetic to Elementary Science, we have a somewhat new view taken. Studies are distinguished as thought studies and form studies. The former exist only logically, but not in ideal educational

methods, yet it is impossible to exactly define and distinguish them. The study of number is classed as a *form* study. Arithmetic stands entrenched in the dogmas of the past, it should give us a broader and better outlook into nature. Exactness is necessary but has been greatly neglected, not for want of mathematics, but for want of proper application. Ninety per cent. of all problems in our arithmetics are either abstract or deal with something foreign to the pupil. They should be of things *common* and *comprehensible. Arithmetic must be applied to science, and the mathematical operation made incidental, but by no means accidental.* Arithmetic is not to be the end, but a means to a more accurate end in thought studies, or science. Baldwin's Industrial Arithmetic is entirely practical, leads the pupil to discover for himself, follows much in the line of the work above mentioned.

Henry T. Eddy, in his address to the American Association, thinks the past teaching of arithmetic has been a failure largely because of an old idea of *discipline* that does not *discipline.* He insists upon more independent research, such as found in schools of technology, etc. Interest is awakened by use. Mathematical talents are not so rare as supposed. *Much more could and should be done in less time.*

The article on Two Paths in Arithmetic, by W. D. Mackintosh, first gives a brief presentation of the early development of counting. Multiplication is certainly the domain of counting, but our authors of text-books have referred it to addition. At first with objects the physical operations, addition and subtraction, were the important things; with multiplication, the mental processes. While the world is busy using the original way, the arithmetics go into group counting, requiring too much mental power, or more concentration than the child possesses. The chief point is the relation of one's possessions to himself. Ego is +, non-ego is—. In this simple fact is the foundation of plus and minus signs.

The falsity of the Grube Method is presented in a thesis by Dr. Badanes. The Grube Method ignores the process of counting, does not avail itself of the advantages of our decimal system of notation; it ignores the serial nature of numbers, begins with deduction instead of induction; it destroys spontaneity, and confuses the child with too many operations with one number; it is a mere mechanism. He maintains that every operation from 1 to 10 reduces necessarily to counting, which is fundamental. Only by real problems demanding solution can we explain the processes in arithmetic.

Directly opposed to this we find Prof. Safford, in his Mathematical Teaching and its Modern Methods, declaring that the Grube Method is unquestionably the correct method of teaching

arithmetic, that the difficulty it presents to teachers is what has caused it to be so little and badly used. "Matter must be digested by the teacher not only in scientific form, but in the form in which it is to be taught." All learning in arithmetic should be by the method of discovery.

The Grube Method as originally given in Leitfaden für das Rechnen in der Elementarschule, nach den Grundsätzen einer heuristischen Methode may be briefly stated as follows: The leading idea in Grube's Method is undoubtedly in general use, but not often referred to as such. Saldon is right in saying that the leading principle is *objective illustration*. The second principle presents the four processes with each number before the next higher is taken up. No new number must be taken up until all the possible combinations have been learned. The first year is devoted to numbers from 1 to 10; the second, from 10 to 100; regular work in fractions is introduced in the fourth year. The first step is from the concrete to the abstract, or the universal quantitative character of numbers; the second proceeds from abstraction to application. The child's greatest difficulty is in applied numbers. Multiplication and division are only forms of addition and subtraction. In a way one operation contains all the others. In measuring or comparing numbers pupils must acquire the utmost mechanical skill. The various combinations are familiar to most every teacher.

Doubtless every one is familiar with Mr. Walker's address on Arithmetic in Boston Schools. He claims that the amount of time is in excess of that which should be devoted to arithmetic, while equally important branches demand more attention. He points out that the study is largely pursued by methods supposed to conduce to general mental training, which, in a degree, sacrifices that faculty and accuracy in numerical computation so essential in all the affairs of life; and that the exercises are so difficult and complex as to not only destroy their disciplinary value, but become a positive injury.

Peterson, Supervisor of Boston Schools, differs from the above in his address to the Board in 1887. He claimed that the time should not be reduced; that arithmetic is especially important for developing mental concentration; that it is not an exercise in logic any more than running and eating are exercises in the science of hygiene; that pupils there are not inaccurate in number work; and that since it has been ordered that simple numerical facts must be discovered by the aid of objects, much improvement has followed.

Prof. Newcomb considers arithmetic poorly taught, and suggests that it should be more like the actual lessons of life, and that some lessons be built on the elements of geometry.

Ginn's Addition Manual applies the word method to addition

and subtraction. He maintains that two-thirds of all errors made are in these processes; that too much number work is given in the first two years; that bad habits are most that is learned; that the child should learn to read the only 45 combinations possible as he would so many words; that $\frac{1}{1}$, $\frac{2}{8}$, etc., are but another expression for 2, 5, etc.; that subtraction should be left until addition is mastered; that the signs + and — are not to be used until later; and that such is superior to the sign method, or the still more complicated Grube Method.

Some valuable hints are given in a pamphlet on Rapid Addition, by Sprague. The writer says that it grew out of experience in the counting-room. We do not need to make the teaching of addition easier, but slower. Grouping is the key to rapid addition, and the child should be taught the different combinations as words, and should learn how to break up others; such as 7 + 4 + 7, where the 4 should be mentally broken into 2 + 2; in all series, such as 4 + 7 + 10, 7 + 11 + 15, etc., the child should be taught that the result is three times the central figure.

Some statistical work has been done which must be considered. D. E. Smith has an article on Sex in Mathematics, based on 10,518 examination papers. Of the men, 63.6% passed, 59.2% of the women. The average of the men passed was 83.7%; of the women, 83.6%. In arithmetic the men stood noticeably higher in every respect; more of them pass, on the whole, and are better in geometry; the difference in algebra is in favor of the women. The same writer gives us an article on Arithmetic in Rural Schools, based on 4,000 reports from 19 normal schools. Twenty-six per cent. pronounce number names to themselves, 33% visualize, 12% imagine them written, and 75% were first taught to count by number names. Taste undergoes a marked change in passing from arithmetic to algebra and geometry; on the whole, it is towards a liking for mathematics. About 46% think analysis the greatest difficulty in teaching arithmetic.

Some tests on Children's Ability to Reason have been made by Hancock by sending test problems to the different grades. Mistakes on same problems were almost as common at 14 as at 12. The movement to introduce algebra and geometry earlier is commended; less number work in lower grades and more arithmetic from 9 to 13 is advised. He concludes that practical arithmetic generally means money transactions; that it is doubtful if children can reason beyond their experience and environment; that practical teaching should utilize this fact; and that ability to solve arithmetical problems varies with the rate of growth, in which girls show a decrease at 9 or 10, and 13, boys at 8 and 14.

A Study of the Mathematical Consciousness, by Miss Calkins,

contains some points of interest. It is founded on replies from 87 women and 30 men, Harvard students. She concludes that on the whole the subjects have concrete rather than verbal memories; that the proportion of verbal memories is five times as large among those who do not like mathematics as among mathematicians, and one and two-thirds as great among algebraists as among geometricians; that students who prefer geometry are more likely to be mathematically inclined than those who prefer algebra; that ease in memorizing is at least as common among those who like mathematics as among other students; that classification and reasoning ability is much more strongly developed in the mathematically inclined; that Huxley is wrong in saying that mathematics is an abstract science which knows nothing of experiment, of observation, of induction, and rests on deduction; and that no important distinction is made between men and women.

Methods of Mind Training is a small work by Miss Aiken, based chiefly on some short drills in the use of numbers. A revolving blackboard is used on which are placed figures which pupils observe for a few seconds, then reproduce in order, add, extract root, etc. In a few weeks, with five minutes' drill each morning, pupils showed astonishing results. Thirty-two miscellaneous numbers, such as 1789, varying from tens to thousands, arranged in four columns, were repeated after a single glance. Figures with dots, minus or plus signs, etc., were repeated; a group of 20 objects recognized instantaneously. The object of these exercises is to cultivate the power of concentrating attention, to quicken perceptive faculties, to cultivate accuracy in seeing and hearing, and to discriminate by immediately observing similarities and differences. It is claimed that the results have been very marked in awakening dull, slow-moving minds to activity, and causing them to take delight in their newly acquired power; that its effects are seen in reading music and learning poetry; that attention underlies the whole of memory, and this is the sure way to attention. Of course it is claimed that attention to these exercises will strengthen the attention for all and any other, and it is here that the claims will encounter greatest opposition.

The practical dominates in French education. This is quite marked in their text-books and treatises on arithmetic as well as in most of their text-books. As early as 1747 Barreme published L'Arithmétique au Le Livre Facile pour Apprendre l'Arithmétique de foi-même, et sans Maître. One cannot help but be astonished at the comparative excellence of this book. The four fundamental processes are given nearly four times as much attention as other works give, until almost a century later. Division is presented only in the form of cancellation, the ar-

rangement is good, and the explanations and diagrams seem somewhat modern.

Lacroix's Traité Élémentaire D'Arithmétique, written in 1811, is well worth considering. It is to some extent both a practical and theoretical treatment of number and its different applications in arithmetic. In the comparison of different objects which fall under our senses, says the writer, we are able to perceive in all, an attribute or quality by which they are capable of being increased or diminished. Such appears, in general, under two forms: as a collection of many particular things, or, of many equally separated parts. (Does not this single sentence contain both the series-idea and the ratial-idea of number?) Soon comes a single whole without distinction of parts, it is as one conceives the distance between two points. The subjects in arithmetic are discussed and it is urged that fractions should be made the key to composite or compound numbers.

Some of the most interesting points from Dr. Scripture's article on Mathematical Prodigies have already been mentioned. In many cases of these mathematical prodigies the result is the only thing that seems to come in their minds. Bidder said it came in the short time it took him to announce the result. The velocity of mental processes cannot be adequately expressed. Precocity in counting is from 3 to 10. Their great peculiarity is the visual images of numbers which they always carry about in their minds. Ampère, Bidder, and Mondeux learned their arithmetic from pebbles.

Binet and Henri find that the mnemonic does not retain figures, but substitutes something else, while the calculators retain the figures as such; that the mnemonic is more powerful but slower than the natural memory for figures. More powerful because his substitution allows him to retain a number almost indefinite; slower because he must reproduce all the mnemonic phrases for numbers.

Binet's Psychologie des Grands Calculateurs et Joureurs D'Echers is full of points of interest. Much of it is consumed in the comparison of Inaudi and Diamandi, an account of which I have given in Genesis of Number Forms.[1] Great calculators are, in general, from unknown or low parentage; they are either slow and dull in learning other things or void of interest in anything else, because they are absorbed in the pleasures and power of great calculations. Their power develops somewhat spontaneously and quite early, without aid and without knowledge of other things. Many of Mondeux's self-developed systems are deduced from algebraic formulas. Many chess-players were

[1] *American Journal of Psychology*, Vol. VIII, p. 521.

questioned; all of them visualize, but only one sees the entire board when playing blind-folded. As a rule, they see only the part where the combat lies.

The Number Concept: Its Origin and Development, already referred to, gives us a full treatment of the development of number names and of counting among primitive peoples. Primitive methods, previously mentioned, are thoroughly presented. Even where the concept appears lowest some circumlocution expresses the difference between *one* and *many*. Much uniformity prevails in counting on fingers, nearly always beginning with little finger on left hand. It appears that races lowest in civilization have also the feeblest number sense, but there are many important exceptions. Some savage tribes carry their system to 10,000 or even a million, while in many it is almost entirely absent. Leigh Hunt could not learn the multiplication table, and peasants in Russia have no idea of even a few hundred. The ability to count is always beyond the numerical vocabulary. Counting words are among the very first to appear in any language, yet they change less than any other part of a language. Kinship in tongue, otherwise remote, has been detected by these words. *With the savage the number concept is entirely concrete.* When number in the abstract is reached then reckoning ceases and arithmetic begins. The tables showing from whence savages obtain their numerals are valuable.

Several other valuable articles and books have been reviewed but space forbids a consideration of them here; however, a list of all so far consulted will be found in the bibliography at the close of this paper.

Suggestions on Text-Book Making. What is said under this head has grown out of eleven years' experience and the present investigation, and is in no wise intended to be dogmatical. The diversity of human intellects, human needs, human environments, child's spontaneity, psychic activity, and especially *mental phenomena in dealing with number*, demand that neither the teaching nor the text in arithmetic should be dominated by a *single* idea. For general use a text-book should be properly balanced between what is known as the *practical* and *disciplinary* use of arithmetic. It is true that each party claims to accomplish the best results in both; but every one knows that most business men work by rules, tables of interest, etc.; know and care little for the whys. It is possible to find good mathematicians well disciplined, but slow, inaccurate, and void of what is termed "good business sense."

In the presentation of numbers we must allow for the spontaneity of the child, for the knowledge of numbers already possessed on entering school, and for the manner in which it

was acquired; begin on the knowledge of the series it already possesses, and make the transition from this to objects. Counting is fundamental and even combinations furnish the first step, hence counting by 2's, 3's, 4's, etc., furnish the first steps in multiplication. The difficulties of subtraction are greater and more lasting than those of addition, hence its introduction on beginning addition must at first be incidental. Care must be taken not to confuse the child by introducing too many processes at once. *Children* do not look at things with adult minds, and it is not necessary to know all about 4 in order to know *any* thing; the processes need not be isolated as they once were, and the simplest fractions may be incidentally introduced quite early, but they involve more relations and hence demand more mental power than the unit. A routine presentation of numbers by the same objects develop *form* rather than number. Problems such as, "How many twenty-sevenths in three-ninths?" were solved by children 5 and 6 in the kindergarten. Ninths and twenty-sevenths were certainly names of some of the little cubes in their toy-box.[1] Such mechanism may prove more detrimental than beneficial.

We must distinguish between a child's ability to perform operations in the relation of numbers and its power to *understand language*. Children often fail because they cannot *read*. A class of 14 failed on a problem concerning a ball with a cavity. Inquiry revealed the fact that only two knew the meaning of *cavity*. I have no statistics of value on which to base it, but my impression from this special study is that children's ability to reason in arithmetic comes later than Hancock concludes; that much of the early work is performed in obedience to a mechanical formula even without the knowledge of the teacher. In the returns, 49 consider the mathematical "insight" a rather sudden innovation; I suppose something like the learning of telegraphy as given by Horter and Bryan.[2] This appears to be true in my own case, but it was certainly due to the manner of teaching and the excessive *help* received. Until further evidence this is a better explanation than to consider it a law of mind growth.

Arithmetical teaching must not be too formal. This is the rock on which our great advocates of analysis stumble. It must not be only an analysis, but a *special* analysis. Only a few days ago an ex-president of the University of West Virginia declared this to be the great evil of modern methods. "My child," said he, "can never understand my solution or see any meaning in it unless cast in a special form. Children's minds are set to a form." The child needs suggestions. Long and

[1] Grube's Method. F. Louis Soldan.
[2] Studies in Telegraphic Language. Psychological Review, Jan., '97.

formal analysis produces confusion and mechanism. Have you any devices in the use of numbers not given in your book or by your teacher? is a question I put to 1,124 children, receiving 407 replies, including 182 devices or departures from the rules; for example, $3\frac{1}{2} \times 3\frac{1}{2} = 3 \times 4 + \frac{1}{4} = 12\frac{1}{4}$, $19 \times 7 = 20 \times 7 - 7 = 133$. Skipping the 5's in adding, keeping a record of them on fingers; never adding 5 to 27, but 3, then 2; dividing a number like 17 into two parts to multiply it, as $17 \times 6 = 10 \times 6 + 7 \times 6$; never having anything to do with 9, using 10 and subtracting; counting percentage backwards; subtracting a number in parts — these are some of the devices mentioned. An interesting example is given in Miss Shinn's observation already mentioned: "How many 2's in 15?" she was asked when $4\frac{1}{2}$. She replied: "There are three 5's in 15, and two 2's in each 5 and 1 over; that makes six 2's, and 3 over makes one 2 and 1 over; seven 2's and 1 over." A young man who had given up his university education came to me for private lessons in arithmetic. He knew absolutely nothing of the subject in book form, yet he was a good business trader. I have often dictated problems to him, the correct result of which he would announce before he had completed taking it down; he was seldom ever able to tell me how he got the result, often receiving no encouragement of its correctness, and after prolonged effort would report unable to solve it. If not crushed by formalism the mind is almost unlimited in its variation.

Why nearly all advanced arithmetics should devote 60 or 100 pages to the four processes, when such has been preceded by one or two books treating them both oral and written, I fail to see. It is certainly not expected that such voluminous books will be placed in the hands of children. I remember when children used to begin in Ray's Third because it presented all of the primary steps, and both teacher and parent decided it was unnecessary to purchase the first books. This is frequently the practice now in the country. The evil results are readily discernible.

Decimals should grow out of common fractions, and in reading and writing decimals the child should know *exactly* the number of figures necessary for each decimal at least to millionths. This can be learned by proper drill in three recitations; then there will be no stumbling over either reading or writing them. This may be called mechanical, but anything is better than the usual confusion we see in enumerating. Make it rational also, that is all right; but immediate recognition of decimals is necessary. To avoid confusion in division, pointing off should precede the operation. Wentworth is the only one I know of giving both of these points.

Reference has already been made to the fact that the ratial-

idea must not be the basis of number in all its development and application, and that as such it cannot explain all of the facts; neither must its value and application be overlooked at the proper time and place. While some base everything upon it, others too much ignore it, even giving proportion a small corner in the last of their text-books. The series-idea undergoes various processes of development in its applications. In its pure mathematical sense, when applied to space and time, the number concept is greatly modified, and differs from its application to familiar tangible objects. In other words exact measure is different from applied numbers. *Number in its first stages of application does not consider equality proper*, but it is only when the idea of continuity is put into number, which is necessary to complete the *oneness* of mathematics, that this equality or ratial-nature is developed. Pure mathematical quantity and number are not identical.[1]

Number is not so simple nor so limited in its application. The *rational process* is preceded by a development which it does not take into consideration. Comparison is a process of reasoning *to which* the number series is applied, rather than *from which* it is developed. This pain is *greater* than that; I enjoy eating *more* than playing; I am fatigued *more* than I was last night, are comparisons of subjective states to which the number concept may be applied in a very indefinite manner. But let none of this analysis stand as an argument against the use of the ratial-idea at the proper stage of development, or even its incidental introduction from the beginning; but it does not

[1] Since writing the above I have reviewed Russell's article On the Relation of Number and Quantity, in *Mind*, Vol. VI, pp. 326–341. It is the most masterly treatment of the ratial-conception of number I have seen, and states this difference clearer and stronger than I had conceived it. "Throughout this abstract development of number," says he, "the unit has become gradually more important and explicit. When it is quite explicit we get a third kind of number, which, outside our arithmetic books, is alone of importance. This kind I shall call *applied* number." Again, "the connection of quantity with number—we must conclude—is due partly to motives of convenience, but mainly to a confusion between two fundamentally distinct ways of regarding space and time. It must be maintained, therefore, that quantity applies to contents only when they are regarded as immediate data, and applies then only when such data are not understood. In this it differs from number, for number can, by abstraction, be applied to material perfectly understood. While things which can be numbered together must have some conception in common, things which can be measured against each other must have no conception not in common, and yet must differ." The idea of continuum must stand or fall with the relative justification of quantity as against number. Much stress is placed upon the distinction made between intensive and extensive quantity. All quantities must be reduced to spatial equivalents before they can be quantitatively treated.

appear that children are capable of reasoning accurately or to much extent until 12.

Having supposed for several years that percentage was quite a blind process to most pupils, in which they closely follow formulas, and that the difficulty lay in the fact that they do not comprehend per cent. as a common fraction, either expressed or understood, I determined to make a test of 224 students, either teachers or preparing to teach. For this purpose 40 problems were prepared involving transactions in gain and loss expressed in common fractions; 81.6% solved all of them; the remainder missed, on an average, over five problems. Later the same problems, the words being changed and the fractions expressed in terms of per cent., were given to 212 of the same students; only 62% solved all, while the average number missed by the others was about 3. It appears that a much more intelligible comprehension can be secured by an interpretation of per cent. in terms of common fractions, such as is well presented in Graham's arithmetic. There ought not to be so much isolation of so many subjects that come under percentage as though they were entirely new subjects. I can hardly account for so many likes for interest and so many dislikes for percentage, especially stocks and bonds.

The rapidly growing use of the Metric System and its exceeding simplicity demand for it more attention than is generally given. It must be remembered that Congress has authorized the use of the Metric System in many departments of the Civil Service.

All of the concrete problems should be followed by sufficient abstract problems to give a more general idea of the application of number. If proficiency and accuracy are to be obtained, the purely drill element cannot all be eliminated from arithmetic. As far as possible problems must grow out of the child's environment.

Upon the suggestions herein outlined a brief review will be made of texts in arithmetic now in circulation and those lately issued, so far as I have been able to ascertain.

The examination of 166 text-books on elementary and secondary mathematics reveals some important points, if they can only be put in a condensed, yet comprehensible form. Nearly all of these are arithmetics, because in arithmetic the application of number is of most interest.

Earlier Text-Books. Robert Record's Arithmetic (ed. 1590 and 1618) reads like a Bible; 260 pages are devoted to the four processes; alligation follows fractions; dots are used for teaching the combinations of numbers; it contains 630 pages, of which fully 500 are consumed in discussion and explanation.

Edward Wingate's Practical Arithmetick and Artificial Arith-

metick (1629) are two books, the latter is written to help the former by borrowed numbers from logarithms. Extensive tables are prepared in interest, etc. All the lower denominations in compound numbers are made out in decimals of the standard. He published another in 1676, in which he first gives the name and number character of all numbers up to 1,000 for English, Greek, and Roman notation.

Cocker's Arithmetic (1677) partakes largely of that idea of "sacredness" once attached to mathematics. "By the secret Influence of Divine Providence," say the author, "I have been instrumental to the Benefit of many: And now do with the same wonted Alacrity cast this, my Arithmetical mite into the public Treasury, beseaching the Almighty to grant the like Blessing to these as to my former Labors." The book has many commendable features, and, judging from the fact that there were 48 editions, must have been quite popular. It is largely taken up in discussion.

James Hadder's work (1719) is much like Record's. Tracing everything to the four fundamental operations, he makes such the dominant idea; but nearly all is devoted to explanation and discussion. Such is one of the chief characteristics of all the earlier books, perhaps somewhat made necessary by the limited knowledge of the teachers. Probably in this respect the contrast between the old and the new is more striking than in any other.

Gordon and Dobson's Arithmetic (1771) contains many very curious problems, rather puzzles. Weights, measures, etc., are introduced just after division. Such is one of the most common qualities of all the old texts. Fractional money frequently follows simple addition, and this is still quite common in English texts. Taken all in all more prominence is given to fractional money, weights, measures, etc., than any other single subject; these nearly always follow the four operations and precede fractions. Temple gives addition of compound numbers on 5th page.

Pike's Arithmetic (1793 and 1797) makes one think of their early school days. Many of the rules, almost word for word, can be found in books somewhat modern. The 6% method is used and interest is placed last, save alligation. I cannot understand the prominence given to alligation by so many. In many it is near the middle, following fractions, but in some it precedes. Several books develop *all* rules on the style of the catechism by fixed questions and answers; but never give a summarized statement of the rule. R. C. Smith and several others proceed with each step, as follows: Q. How do you begin to divide? A. As in short division. Q. How many steps are there? A. Four. Q. Name them. Such as this is found on every page.

Walsh (1814) gives no rules, only a few suggestions to the teacher. Motto: *Iter est breve per example.* James Robinson (1825) introduces long division before short division. In this and other particulars it should be classed with texts of the last decade.

Emerson has the number series and their names to 100 learned first. Butterworth has the pupil to express first in words, then in figures, even as high as 6,100,192,204. Porter's Ready Reckoner (1843) applies cancellation to every part and gives *every* rule by directing what to place on each side of a vertical line. Hilliard's two volumes are full of devices and short cuts in arithmetic.

Colburn's Arithmetics (1849) once had such a wide circulation and the plan so well understood that little mention need be made here. This plan objects to explanation on the part of the teacher and leaves the child to work out his own salvation. Written work is discarded. The later editions have introduced much not found in the original. Horace Grant's Arithmetics (1861) presented in England the Inductive Method. Mental arithmetic is claimed to be of fundamental importance. Nearly all the work in both books is mental. The subjects treated are very much reduced; are on the same plan as Colburn's; were once quite popular in England. Walton's Pictorial Arithmetic (1866) is full of pictures of all kinds that may be counted; reduces it to object lessons. Burchett's Practical Geometry (1855) holds the lecture method by which the teacher makes drawings on the board, pupils take notes, and make careful drawings afterwards. No figures are given.

Leysenne's La Deuxième Année d'Arithmétique devotes considerable to compound numbers; square root follows numeration and decimals. It introduces geometry to a considerable extent, and the commercial element occupies a prominent place. It is in many respects an excellent book.

The general characteristics of the earlier text-books on arithmetic may be stated as follows: Extensive discussion and explanation which made the volumes comparatively large; the arrangement by which great prominence is given to fractional money, weights, etc.; stress laid on proportion being placed before fractions in some cases; the assignment of interest rather to the last part of the book; and the peculiar problems, often puzzles. On the other hand, many of the presentations of primary number, such as Emerson's Elementary Lessons, have not been greatly improved upon; many sets of problems are unsurpassed. The short cuts and devices which business men use so much are obtained almost entirely from these old books. The disciplinary idea may be detected in many, yet, on the whole, the earlier books were dominated by the *practical* idea

no less than those of the present day ; but the practical was not so generally accepted.

Later Text-Books. Milne's Standard Arithmetic introduces many purely number problems in the simplest processes of addition and subtraction, etc. The presentation of decimals is defective ; proportion is somewhat slighted ; 7 pages of inadequate treatment of the metric system is presented near the close ; percentage is likewise defective by not being based on common fractions ; mensuration is well treated, and the review problems are excellent. The book aims to be both disciplinary and practical.

White's New Arithmetic presents many commendable points. Counting by 4's, 7's, etc., is in strict harmony with the development of the number concept ; fractions, decimals, and the metric system are well presented. Percentage seems to be too much wedded to formulas. Proportion precedes roots in its proper place. Problems are practical and well graded.

[1] Moore's Grammar School Arithmetic applies the Inductive or Laboratory method throughout. Not a single rule is given, and the pupil is left to devise the definite processes. First the concrete, then the abstract corresponding to it. The simple processes occupy 48 pages, the presentation of which is very good ; the treatment of fractions is up to date. The subjects are repeated somewhat on the Spiral-plan. Too much space is devoted to denominate numbers. We can well see how such a book would be all right in the hands of competent teachers, but there is a gap between the subject matter therein presented and the child's knowledge that must be supplied some way. If all teachers were able to properly assist the child in developing the proper manner of procedure, this great objection would disappear, but the majority of teachers are young and inexperienced. I am unable, for example, to see anything to guide the inexperienced teacher and pupil to an understanding of decimals. Whether the book presupposes some knowledge of such, I do not know.

[2] Hewett's Arithmetics, Primary and Practical, are on a somewhat new plan, and in every way justifies the title *Practical.* The rules are few, suggestions to the point ; little distinction of classes or cases problems is made ; the pupil is left to sort his problems in percentage, etc., and to make the application as he must do in practical life ; all subjects not considered practical are omitted. A better treatment of percentage and interest I have not found. On some points the student is liable to confusion, which is a stumbling-block with all learners ; decimals

[1] Lately published.
[2] Lately published.

are developed from the unit; the metric system receives but a passing notice of 3 pages as the last subject. In the main the work is too true to a single idea.

[1] E. E. West's Twentieth Century Arithmetic, in two parts, presents a few modifications of interest. The second part is the first grammar school text I have found that does not treat extensively the four processes. This opens with as extensive and *complete* consideration of fractions as can be found anywhere. Decimals and percentage might be improved; the metric system is well presented, and the equation of one unknown quantity is introduced in such an incidental manner that it cannot help but be beneficial to the student, and at the same time free from any opposition to those who oppose the logical method. The book is small but comprehensive, and devoted to the practical.

Walsh's work includes a series of three books, on what is called the Spiral-plan, that is taking a little of a subject and returning to it again, perhaps several times. This differs from the frequent review problems in that more subjects are introduced early in the course, and treated less extensively. The practical omission of rules and definitions is noticeable; decimals are well presented; the chapter on geometry adds to the work, for geometry should be introduced incidentally much earlier than it is. The equation is used especiallly in percentage and interest. Several systems of texts present something of this nature, but I have found nothing that carries this plan so far. If carried out in this form one cannot help but think that it will lead to a lack of organized knowledge, if not confusion on the part of the pupil.

The Venable series subordinates the theoretical and technical to the practical. The Elementary is somewhat on the Grube style; it is good in the presentation of measures. The Practical devotes 63 pages to the four processes; rules are long; the metric system is placed in the appendix.

Sanford's works are old in the presentation of elementary numbers; fractions and compound numbers are well treated; the arrangement is unsatisfactory.

Baldwin's Industrial Primary Arithmetic claims to be the natural way of teaching numbers, leads the pupil to discover for himself. Class work and seat work are separated. Everything is presented in the common, practical, business way. Arithmetic must be studied solely for its application to business life. It is the best example of the practical idea, pure and simple, I have seen.

Prince's Arithmetic by Grades includes eight small works on the Inductive plan, the most excellent points of which are the

[1] Lately published.

treatment of fractions, the introduction of the elements of geometry in the 4th grade which is gradually increased each year, and the excellently graded problems. There are no rules, but suggestions and diagrams somewhat take their place. If used in graded schools and by experienced teachers no difficulty would be encountered. They also repeat the topics in the grades. In the presentation of primary number some improvement might be made.

Graham's Common School Arithmetic has ratio as its fundamental principle, and is founded on the *intensive* or disciplinary idea. The same may be said of Speer's, McLellan and Ames's. Two elementary works by Miss Bacon go with Graham's. His work treats the four operations somewhat differently from most; thus, $2 \times 4 = 8$; $\frac{1}{2} \times 8 = 4$; $4 \times 3 = 12$; $\frac{1}{4} \times 12 = 3$. Tables of such are quite extended, and, without doubt, to *much advantage*, both in multiplication and in fractions. Proportion is treated more than usually and is placed before percentage; the metric system is practically ignored; decimals could be improved. Fractions and percentage are admirably treated. The work is wedded to the idea of ratio and discipline.

Speer's New Arithmetic, in two parts, is absolutely devoted to the idea of comparison as a means of developing accurate judgments. A set of blocks of various kinds and sizes go with each book. The Primary begins by having the child find or handle these solids; bring a *larger* or *smaller* one, the largest and smallest. Comparison in colors is introduced at once. Look at four colors, think the colors (eyes closed) from top down, from bottom up. Which is second from top, third from bottom, second from bottom, etc.? Relative magnitudes of all kinds are pointed out, largest solid, smallest solid, tallest boy; compare the height of pupils, largest surfaces of solids, etc.; then an exercise comparing sounds, etc. Show the longest edge of the largest solid, shorter edges. Cut a slip, cut a longer one, shorter one, larger square. Draw a line, one a *little* longer, shorter, etc. Draw a line, separate into equal parts, show one-half of it. By means of such comparisons of blocks, lines, colors, etc., the work proceeds step by step. The Elementary is also accompanied by a *large* collection of blocks illustrating integral and fractional relations. Ratios consume the greater part; interest and percentage are developed from ratio. Much of this kind of work has been done in our best school, but only in a few instances has it been made the whole of arithmetical training. No other series of text-books follows such a line exclusively. McLellan and Ames's work claims to be founded on the idea of number as measurement, yet both the subject matter and the treatment are entirely different from Speer's. So far as I am able to judge, Miss Walter, of Willi-

mantic Normal Training School, has been practicing Speer's plan for some years in the model school, in about as pure a form as it can be put. Doubtless such work should have a much larger place in our schools. The high value of comparison added to acute attention is of the utmost importance in all reasoning processes whatsoever. The great function of the work above cited, and to some degree of all the other books in this line, is to dress up thought and to make general thinking more acute No teacher should be blind to its great value, but at the same time such an *exclusive treatment ignores some of the fundamental facts in the nature and application of number.* One may be well trained in all the geometrical and quantitative comparisons and yet be void of good business sense in arithmetic.

[1] McLellan and Ames's Public School Arithmetic is based on number as *measurement.* The ordinary drills in the four processes cover the first 74 pages ; many of these are pure abstract exercises in numbers, but money value and linear unit play an important part. The four processes are followed by four pages on Comparison of Numbers, and this by square root. How square root to three and even four places is to be made *rational* at this period of development one may well inquire. It must presuppose much more knowledge of arithmetic than the previous treatment indicates. Fractions are handled in an excellent manner ; decimals are made to grow out of the dollar and the metric system ; however, the metric system is the last chapter in the book. The same difficulty to join the practical to the philosophic idea of number that is evident in The Psychology of Number is made still more evident by this book. One looks in vain to see in this work any great difference from half a score of others. It is by no means as true to the idea as Speer's.

Griffin's Supplementary Work in Arithmetic (1893) is a rather large work including lines, areas, volumes, bulk and percentage, and is based, in the main, on the measuring idea. Various figures and drawings are given and many questions concerning their comparison. If judiciously used by the teacher in connection with other work it cannot help but prove of great value. The author appears to have no special method or theory to present, nor does he think of making it the whole of arithmetical training.

Franklin's New Arithmetic, by Seaver and Walton, presents no new departure of note, but is none the less pedagogical. The First Book contains several commedable features. The processes are rather incidentally introduced, but not confused, and counting, in various ways, receives attention. The chief points of excellence in the Second Book are found in both the

[1] Lately published.

number and character of the problems and the rather incidental introduction of subjects.

The Wentworth series has had such a wide circulation that they are doubtless familiar to all teachers. The Primary follows somewhat the Grube method of presentation, and the simplest fractions are introduced early by use of objects and diagrams. Decimals are presented and are followed by the most excellent primary treatment of percentage I have seen anywhere. His Practical Arithmetic contains 372 pages, and presents the usual elementary treatment of numbers in the four processes. That drill in the four processes is the main thing in arithmetic may be offered as a justification of this practice; but why children capable of handling this and having had the two previous ones, should need drill in adding $5 + 8$, etc., in subtracting $22 - 3$, etc., and in similar simple operations in multiplication and division, I do not understand. The treatment of decimals, common fractions, and percentage is not susceptible of much improvement, save that decimals precede common fractions, and little more prominence might be given to reading and writing decimals according to the number of figures required. This series is a medium between the purely disciplinary and the purely practical, between the purely rational and the purely mechanical in arithmetic, between the thoroughly inductive and the thoroughly deductive. They are neither dominated by a single idea nor spoiled by method.

Besides the above, Wheeler's Arithmetic, Primary Number Lessons and Advanced Arithmetic, by the State Board of Education, California, Ray's series, J. M. White's Oral, Brooks's Mental, Bailey's American, Robinson's series, and Atwood's Graded, arithmetics are used in different sections of the country, and several others are quite limited in their circulation. Other books which I have not been able to secure may be extensively used. On account of necessitated brevity and lack of space, I have thought it best to confine my review of later texts to those of this country, although several others have been examined.

The German books are quite conservative, introducing the practical, but clinging to the disciplinary. Each step must be thoroughly mastered, and mathematics taught as a unit. The French make much of the decimal or metric system of measures, etc.; induction, as presented by Grant and Colburn, has not much place, books are seldom without some rules, but they are quite exact and clear. The English texts adhere to deduction in some form. In the oldest books currency, weights, etc., nearly always follow division, and occupy much space, and are often introduced with addition; alligation receives attention. The marks of the *old* are very evident in all of the *new*.

Among the great diversity of opinions in the articles and

books above reviewed, it is evident that there are four general lines of thought: (1) Those who hold and treat arithmetic as a system of logical reasoning, highly suited to develop the mind, and place it more on the plane of pure mathematics; (2) Those who consider arithmetic useful only, or in the main, for practical business life, and would make the shortest cut possible to this end; (3) Those who base all instruction on induction, omitting all rules and explanations, resorting to the laboratory method or method of self-discovery; (4) Those who cling to the old idea of deduction from fixed principles or rules. Omitting some differences in the presentation of primary numbers, nearly all other differences, and many of these, are involved in these points. The first two classes differ concerning the end and the nature of arithmetic; the other two concerning the best means for obtaining the desired end. Those seeking discipline, or development of judgment, may use either the inductive or deductive method; likewise some maintain that the practical is best obtained by memorizing and applying rules; others claim that the most direct and thorough way to secure the practical results is by induction from real transactions. Only a few occupy either of these extreme lines, and there are all grades of compromises, or attempts thereat. Perhaps few would claim to belong to the first or second classes as presented, especially the first, for those who make arithmetic a means to develop accurate judgments also claim to realize the best practical results.

That practice does not always conform to theory and philosophy is manifested in the texts on arithmetic. Notwithstanding the varying theories and methods discussed in prefaces, books, etc., one only needs to put aside about one-half dozen of our latest works, and the differences in the remainder are practically not worth mentioning. The teaching of arithmetic is the most traditional of all subjects; its methods have come down less changed than any other topic, and by many it is thought to be the worst. It is in the presentation of primary numbers that the devices of teaching are so opposite. The mathematical mind was a late development in the race, and so it is in the individual. Too much value is often attached to the abstract manipulation of numbers, and the believer in the concrete often fails to realize the necessity of an intellectual evolution into the higher forms of mathematics. "Skill in computing may be acquired without any intelligent apprehension of arithmetical science, and a profound insight into the truth and principles of arithmetic may be attained without much facility in using numbers."

V. Conclusion.

The main inferences from this work may be briefly summarized as follows:

That the number concept is the outcome of a long process of development marked in the race and in the individual.

That the first step is the formation of a series-idea by the innumerable variety and successive changes in consciousness.

That this develops an abstract idea of succession, manifested in children's desire to follow in various ways any series, and especially in mathematical prodigies.

That prominence *is* given to certain members of the series by the various rhythmic processes as illustrated by the experimental work reviewed, and by the great preference given to certain numbers.

That there is a counting period quite marked in children and to which the mathematical prodigy belongs.

That the number, time, and space concepts are closely related, in their nascent state at least, and this relation gives number a wider application.

That dramatization of numbers, number forms, and prodigies belong to the counting period.

That *some movement* is perhaps unavoidable in the early stages of counting. If the motor element be a necessity of all thought, it is even more so in following an abstract series.

That the application of the series-idea to things is the second and more conscious step, hence the difficulty.

That number as measurement is not the whole of the development of number, but only the complimentary side of the series-idea.

That number as measurement can by no means explain all the mental phenomena of numbers.

That the power to manipulate the series bears little or no relation to the development of reason and general judgments.

That number has applications not in a pure mathematical sense as an exact quantity.

That there is a great variety of mental phenomena found among children and adults in connection with numbers.

That the chief lines of discussion concerning number and texts on arithmetic are directed towards either the disciplinary or practical end, the deductive or inductive method of presentation.

That arithmetics and methods of teaching have remained, comparatively speaking, quite constant until the last few years.

That the chief defects in texts are found in the presentation of primary numbers, fractions, decimals, proportion and percentage.

That there is a general tendency in this and other countries

to introduce many of the elements of geometry and, at least, the simpler uses of the equation into arithmetic, the former of which, at least, is to be commended.

That the authors of text-books seem to be searching for methods and often ignoring the manner in which the race and the child naturally acquire such knowledge.

That no method should ignore the long psychic and rudimentary stages of development. Yet if allowed to play too great a part, morbid conditions may be developed, such as seen in morbid counters, excessive counting on fingers, etc.

That the great diversity of human intellects, human needs, human environments, child's spontaneity, of mental phenomena in the development and application of number, forbid the exclusive use of any one orthodox method in teaching number and arithmetic. (We have already reached this generalization in teaching reading.)

That practical business training in arithmetic, and preparation for higher mathematics and abstract thinking in general are not identical, nor obtained in the same way.

I must express my great obligation to Drs. Hall, Burnham, and Sanford for valuable assistance — especially to Dr. Hall for suggestions and criticism; to Prof. Luckey, of University of Neb., to Prins. Barnes, of Fairmont Normal, W. Va., Deahl, of West Liberty, W. Va., Miss Williams, of Trenton, N. J., students of these institutions, and others, for valuable returns; to Supt., teachers, and authorities of Worcester schools, for assistance and privileges; to other schools rendering assistance; to different book companies for granting the privilege to examine their publications and for books donated.

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A NEW FEATURE IN MANUAL TRAINING.

By Gertrude A. Stoker.

Whittier in his immortal poem "Snow Bound," speaks of "a chill no coat however stout of homespun stuff could quite shut out," transporting us in imagination to the time when mothers not only designed and made the clothing for the numerous family, but spun the flax or wool and wove the cloth. "Store clothes" were then unheard of. In the schools of that generation, two short terms constituted the year's work and long vacations gave ample time for home duties. The physical and manual training of a girl came during the time she worked by her mother's side, assisting her to make carpets from bits of rags, braid rugs, knit stockings, to cut and make articles of clothing, besides the various household duties, such as sweeping, dusting and cooking. This necessity to express thought through manual labor, did more to educate the girl to use her powers, to develop her self-hood than the knowledge acquired in the poorly kept schools.

Modern inventions have so modified modes of living that the necessity for manual training in the home has almost completely ceased to exist. "Store clothes," "store carpets" are universal.

To-day the school year means ten months of severe application, with music, dancing and French crowded into Saturdays and vacations. In many cities, the children are obliged to prepare from two to three lessons daily, outside of school, which leaves but little time for recreation.

The vast majority of girls know nothing about sewing. This fact, although deplorable, is an outgrowth of modern inventions. Thoughtful teachers seeing the importance of mental development through manual training, and realizing the abounding energy and ceaseless bodily activity of children, advise supplying them with concrete material upon which to expend their energy. As manual training has ceased to exist in the home, the school must meet the exigency.

Several years ago manual training was placed in the course of study for St. Paul. One hour a week was devoted to this work. To the boys were given problems which they drew following the teacher's dictation. Later these were made from wood in the shop. In the fourth and fifth grades the drawings gave one view of some solid and the problems were made from thin wood. In the sixth grade, working drawings of simple

geometric solids were given and the problems constructed in wood. Some useful articles were made in this grade. In the seventh and eighth grades, models requiring greater skill illustrating the application of simple joints used in practical wood-work were made, also apparatus used in school work.

While the boys were busy with their wood-work the girls were taught to sew. Small pieces of unbleached cloth were supplied which were cut exactly four by five inches. Upon these pieces the teacher drew circles or squares.

The girls were taught first to outline these forms with the "running" stitch. When this was accomplished to the satisfaction of the teacher, similar pieces of cloth were given to them upon which they "back-stitched" circles or squares. If my memory serve me correctly, pieces of red and white striped calico were then supplied. These the girls tore into two parts turned each edge and sewed together "over and over." They then sewed two selvage edges together "over and over." Next came the hemming stitch, then gathering and putting into a band, and finally they made four button-holes, one inch apart, on a piece of cloth six inches long. At the end of the term, these pieces being of no value, were thrown away.

In the seventh and eighth grades the girls were obliged to bring from home aprons, skirts, and nightgowns, upon which they worked for a whole year without finishing. Much dissatisfaction was felt by the teachers on account of the lack of interest manifested by the pupils both in sewing and wood-work. The results were disappointing.

Under the guidance of a very able teacher the following experiment was tried in an out-lying district where the children came from homes of limited means. The average age of the class was fourteen.

The work as described, was completed in four months. One hour per week of school time was taken, but some who became very much interested worked outside of school.

Each girl provided herself with a box which she carefully lined. This she equipped with a thimble, two spools of thread, a paper of needles, some pins and a pair of scissors. Small needle books and pin cushions were made to complete the box in its furnishings. Each girl contributed a small amount of money with which to purchase a doll. A committee of three was appointed for this purpose, but all the toy stores in the city were visited, not only by the committee but by each girl in the class, before this important purchase could be consummated. Should the doll have brown hair or golden; should she be able to cry or be voiceless; should her joints move or not; should her body be made of kid or cloth, were grave matters for weighty discussion. At last a good sized doll about eighteen

inches long, with a kid body, bisque head, yellow hair, and blue eyes, was brought into the schoolroom by the committee of three who had secretly shown it to each girl before school, occasioning whispered ejaculations of "Oh! how beautiful!" "Isn't she dear?" "How sweet!" Nothing seemed too good for the doll's wardrobe. The girls wished to buy silks and fine material but, although a good quality of cloth was chosen, no extravagance was allowed. With few exceptions the material was obtained from mothers' piece bags. With tape-measures and tissue paper the girls proceeded to make patterns for the clothing. For the underwaist they measured the length of the body from neck to waist, the length of the body under the arms, the length of the shoulders, the width of the back and the size of the waist. Allowing for seams they cut their patterns, basted them together and tried them on the doll. In a similar manner they made the patterns for all the clothing without other assistance than the very able suggestions and criticisms of their teacher.

As far as possible the girls were allowed to choose the articles of clothing which they desired to make. The underwaists were made of heavy cloth furnished with a strong band and buttons for the drawers and elastics. Glove-buttons were used for the back. The neck and sleeves were finished with lace neatly sewed on "over and over." A combination suit was made from an old blue silk vest cut to closely fit the body. The neck was finished by a crocheted edge of blue silk. The under skirts were made of white flannel finished at the bottom with a beautifully embroidered edge done with white silk. The seams were cat-stitched with white silk. One of the two long skirts was tucked by hand and finished with lace and insertion; the other was plain, finished at the bottom with a simple hem. The nightgowns had plain yokes edged with lace. All the seams were felled. Three dresses were included in the outfit. The work-dress was made of gingham with a simple hem at the bottom. The waist had a yoke with the cloth below fulled on. The sleeves were rather full and finished at the wrist with a band upon which lace was sewed. To accompany this dress was a gingham sun-bonnet and two white aprons. A pretty wool dress, thoroughly "up to date," was made for street wear. To accompany this was a cloak made of blue eiderdown cut with a yoke. A Russian hood of the same material and a white eiderdown muff and boa. A pink mull afternoon dress was prettily trimmed with narrow ribbon. It was cut low at the neck with a full ruffle for finish. The sleeves were puffs reaching but to the elbow. A crocheted sack was made for house wear. Two handkerchiefs were made of fine linen hemstitched and edged with lace. This doll was

also supplied with sheets, pillows and pillow-cases, a cream cheese-cloth comfortable tied with blue, and table linen.

She was named Anna Evalyn Gertrude Monroe, to do honor to the teacher, the principal, the supervisor of drawing and the school.

Miss Monroe's influence soon began to penetrate the homes. Interested mothers visited school to return to their neighbors with glowing accounts of the capabilities of their daughters. Fathers came seemingly to inquire after their children's progress, in reality to see the doll.

Although in the early stages of the work the boys had looked askance at the various articles of wearing apparel which the girls inadvertently allowed them to see, gradually their timidity or assumed indifference was replaced by interest which occasioned many helpful suggestions. Later a desire to contribute to the outfit was noticed.

Already many wooden work-boxes had been presented to the girls by interested boys. Then one by one the girls were presented with needle-book covers, made of thin pieces of wood neatly carved, until each had one. The suggestion to make a set of furniture for the doll was received with great enthusiam. One article has been completed. It consists of a chest of good proportion, about thirty inches long, made to contain the wardrobe. The sides and top are covered with carved designs cut with the knife. It is most elaborate in design and perfect in finish, without exception the finest piece of work ever done in our grades.

The boys are still at work upon the furniture. According to the teacher's plan they first submit their original plans for criticism, after which they work out in wood the furniture which they have designed. Much of this work they do at home, and what the results will be we cannot now tell.

What to do with the doll now became a matter for serious deliberation. At first some thought to obtain money for their library by selling it, but the children had grown to love their offspring and the sentiment — "It's like selling one's own baby," seemed to fill each pupil's heart. To give it to the "Babies' Home" did not quite meet with approval. At last, the very happy thought of presenting it to their kindergarten seemed to satisfy all. So, one morning, with much ceremony and a great deal of suppressed emotion, they had the pleasure of presenting Miss Monroe and outfit to the little children, whose eyes grew larger and fuller when they gazed upon the wonderful doll and were told that it was all for them.

Miss Monroe's influence has spread to other rooms and to other buildings. So many dolls were dressed that the Babies' Home was not slighted. Dolls of different nations, to use in

geography, were dressed in some schools. The very best work that the girls were capable of doing was put upon these clothes. It demanded helpful suggestions and criticisms from the teacher, but no coercion was necessary to secure good results. Many stitches were taken out to be done again, but a cheerful atmosphere always prevailed.

The reason why the work in this case was a success when formerly it had been unsatisfactory was because sewing was not done for sewing's sake, but as a means to an end, that end being the expression of the natural instinct of construction possessed by all children. Behind the drill in sewing, which was given to acquire skill in execution, was the impelling energy of natural instinct to make something.

Children not only desire "to make," but they like to finish quickly that which they make. Had large garments been given to them, much discouragement would have been noticed before the completion of the work, but upon the doll's wardrobe lack of interest has never been seen.

Sewing isolated from the hearts of the children is dead, mechanical drudgery, but when used as a means of expressing that instinct — mother love, it becomes a happy occupation.

AN EARLY PHASE OF THE MANUAL TRAINING MOVEMENT—THE MANUAL LABOR SCHOOL.

By JOHN A. HANCOCK.

During the first thirty years of this century there swept over this country a general revival of educational interest, which manifested itself in a variety of ways. Through its influence the free school system was either established or modified in a majority of the States. Private schools, church schools, academies, seminaries, and colleges sprang up in large numbers, both north and south. Public men found in education a topic that readily gained for them attention.[1] The publication of school journals, notably the Annals of Education and the Journal of Education, was begun. School text-books in great variety were printed. The educational ideal of the time was to get and diffuse *useful* knowledge. For this purpose societies were formed which became numerous enough to affect not only State, but national organization.

Among the many crude experiments tried not only here, but abroad, in this period, were the infant schools, the monitorial system, and the manual labor schools. The infant school disappeared and was revived in the form of the kindergarten thirty years later. The monitorial system was widely popular and continued as a method for giving instruction in the public schools till within the memory of the present generation. The manual labor school, too, had its period of rapid growth and decay. It deserves, however, to be better known, because it was a phase in the development of the manual training movement of to-day, and the purpose of this paper is briefly to describe it.

To be appreciated it must be studied in its relation to the general movement of its time. The apprentice system was beginning to decay. It had produced competent mechanics for generations, but now had to face the growth of the factory system, the introduction of steam power, the division and subdivision of trades, the attractions of the professions, and of commercial life. Moreover the schools of the time as well as those of to-day trained for a quiet life rather than one of activity.

There was a great desire for a "practical" education. Working men became imbued with the movement for improvement, and Mechanics' Institutes sprang up here, as in Great Britain, in all of the larger towns and cities. It was to the efforts of the one at Providence that the very early establishment of the graded school system and the institution of the first superintendency of city schools in this country was due (8). Farmers' Book Clubs and Agricultural Societies became equally numerous.

The educational system that had been handed down to the people included nothing of physical training. This had hardly been necessary in the early colonial times. The spirit of patriotism which the revolution stirred resulted in an effort to make military training a part of the curriculum of every public school. It did not, however,

[1] For example, Jefferson in Nile's Register, Vol. X, pp. 34–37. and Madison in Vol. XXIV, p. 202.

pass beyond the stage of agitation in any State. Its only result at that time was the establishment of the military academy. In more recent years it has assumed an interesting phase in public schools, academies and colleges. The German turning became suddenly popular in 1825, and lasted for a year or two, long enough to gratify the curiosity of the people. Several minor efforts resulted from its influence, notably in the Round Hill School at Northampton. Gymnasiums were opened in this same year at Harvard, Yale, Williams, and Brown, but the day of the medical director was not yet.[1]

It was in the effort to popularize education, to give the poor a chance, to substitute something for the apprentice system, to preserve health and give "practical" preparation for life that returning travellers heralded with a religious fervor the manual labor school of Fellenberg and began the establishment here of similar schools.

Prior to this, however, the idea had been advanced in this country as early as 1786, in the Columbian Magazine (1). The anonymous author calls it "A Plan for establishing schools in a new country, where the inhabitants are thinly settled, and whose children are to be educated with reference to a country life." A tract of 300 or 400 acres was to be set aside, upon which a school building, house, barn, and workshop were to be erected. The farm was to be supplied with tools, implements and live stock. A manager, assisted by a farmer, gardener, cook, and male and female teachers, was to have charge. Children were to be admitted between the ages of eight and fourteen. The boys were to learn reading, writing, the elements of arithmetic, gardening, farming, stock raising, cider making and beer brewing, and if time permitted, geography, history, geometry, surveying, and bookkeeping. The girls were to learn "all the arts of domestic economy" —what else is not stated, though much may be inferred. Each boy was to have a plot of land to cultivate the year through. What he produced on it was to be his own. The expenses of his schooling were to be met by his own labor. In summer the boys and girls, separately, were to study each two hours, forenoons and afternoons, and work during the remainder of the day. Eight hours of teaching would be done by the "master," after which he was to help in the fields.

The advantages of a school like this were held to be training to habits of industry, religion, morality, behavior, preparation for actual life, besides a great uplift for the community.

Ten years later, Dr. John de la Howe, of South Carolina, left by will (2) property for the establishment of a school modeled on this plan. In 1807, the plan was put into operation. The property of the school in 1824 had increased to $42,000. No other statistics of the school are available. It certainly was not a factor of consequence in the general movement.

This was, as has been said, inspired by the labors of Fellenberg, who got his idea in part from his friend Pestalozzi. The French invasion of Switzerland brought ruin to much of the country. Moved by a spirit of patriotism and philanthropy Pestalozzi gathered a group of the wandering orphans together on a small farm and made for them what home he could. How to train them for self-support was his problem. He taught them gardening, farming, and such work as their necessities demanded. So great was his success that he conceived that in industrial training lay the social, moral and religious reform of Switzerland. With the re-establishment of order in the country his school was scattered. He repeated the experiment in later years but all his efforts resulted in financial failure. Fellenberg took up the

[1] The history of the movement for physical training has been written by Dr. Hartwell in his reports to the Boston Board of Education.

problem and devoted his fortune and ability to founding and carrying on an institution that should effect this object. He believed that the class organization of society was right and was of divine origin, yet the condition of these classes might be greatly improved and their relations to each other harmonized. Agriculture, he held to be the natural imployment of man; the country his rightful home. "There the pure air, the influence of vegetable life, the regular habits and salutary exercises connected with a country life produce a vigor of constitution and an energy of character in an agricultural population not found in the mass of those who are educated in the city."

He purchased the estate of Hofwyl near Bern and prepared for his great work. There he hoped to avoid the precocious, superficial development which city life gives children. Beginning in 1806 he opened first a school for the training of teachers. This training was in harmony with the conditions which necessitated each teacher to cultivate a small farm in order to supplement his meagre salary. By this kind of a school Fellenberg hoped to reach a large body of the people indirectly. Additions were made at intervals to the estate. Workshops were built for making and improving agricultural implements as were others for making clothing. A printing house was built. An agricultural school for educating the laboring classes, was begun. Later, trade schools and an academy for the higher classes of society were added. The agricultural school had for its purpose the giving of a common school training to poor boys and fitting them for farm life. It was hoped to realize from their labors enough to clear the expenses of the school. The school was maintained, though not by this means. The editor of the Annals of Education spent three months there and published in 1830 (3) a series of articles descriptive of the institution and its methods of work. He says of this school: "It is intended to . . . train children to a life of labor and especially to an agricultural life; and to cultivate their intellectual and moral faculties at the same time, that they may understand the processes they perform and appreciate the importance of the advantages of the duty of industry instead of engaging in it as an arduous labor.

Pupils are wakened at half-past four or five according to their ages; half an hour is allowed them for making their beds. After a lesson of an hour in summer and an hour and a half in winter, they attend devotional exercises and breakfast. Here the task of each division is assigned. At eleven o'clock they return to dinner and then have a second lesson of an hour and a half. At five or six according to the season they have a piece of bread and a third lesson of an hour and a half. At seven or half past they sup. An assembly is then held for the review of the day. It is closed by devotional exercises; the younger children go to bed, the elder again receive instruction or occupy themselves in some other way."

Nearly every Swiss canton founded such schools. Switzerland had become for other reasons also an attraction to the educational world. Visitors flocked in from every part of Europe. The labor school idea was taken up and the experiment repeated in England, France and Germany where it is not now intended to follow it.

In this country it was developed on the lines of reform schools, and in both elementary and secondary education. The schools can not be said to have been indigenous. The model in Switzerland was closely followed as possible. The second manual labor school was founded at Gardiner, Maine, in 1823. Shortly afterward an attempt was made at Derby, Conn. The school was short lived like so many others, failing financially after a year. Concerning it one of the pupils tells us (4) "that it had fifty or sixty pupils of both sexes. The school was an

attractive and pleasant one, and those who were so disposed made good progress in useful learning. Several of the boys were entrusted with surveying and leveling instruments, and used them frequently and successfully. The boys rambled extensively over the hills of that region, did some work in hoeing corn and potatoes, and in making hay, and once made a pedestrian excursion to Lane's mine at Munroe. The work of the school was harmonious, a spirit of study prevailed amongst the pupils and the supply of out of door sport was ample."

Perhaps the first annual report of the Manual Labor Academy at Germantown, Penn., reflects best something of the character and spirit of the average school of the kind. It was established in 1829 and was equal to an ordinary high school of that period. Mr. Woodbridge's review (5) of it exhibits, too, the feelings of the supporters of the movement. He says: "To Saltzman, Pestalozzi, Fellenberg and their contemporaries seems to have been reserved the glory of proving to the world by a series of persevering but successful experiments that there is no necessity of sacrificing the body for the sake of the mind and heart; but, on the contrary, that mental and moral improvement can be far more successfully prosecuted by devoting a portion of time to agricultural, horticultural and other manual labor. . . . .

The premises (of the school) consist of forty-two and a half acres of land, several outhouses and a commodious dwelling. The farm is in the rear of the dwelling. There is a stable, coach house, granary, cart shed, farm yard, and also a garden of a third of an acre.

"The youth have respectable talents, habitual industry, and are pleased with the mode of education. Their health has been uninterrupted except in the few cases diseased when admitted. Every individual has been restored to health. All board with the principal. Their diet is plain and in as great variety as is consistent with economy and health and is as much as possible products of the pupils' labors on the farm.

"Piety, learning and honesty are here united. Surely such an enterprise cannot fail. The usual branches of study are perused in addition to the Bible. The hours of recreation are not hours of waste and idleness and immorality. They are employed in useful bodily labor such as will exercise their skill, make them dextrous, establish their health and strength and enable each one to defray his own expenses, and fit him for the vicissitudes of life. . . . . Thus far they have been employed in carpenter work, farming and gardening."

In New York five such schools were incorporated. They all failed financially after a few years. All dropped the manual labor feature and survived under other conditions. Of the five, the Yates Polytechnic Institute is of greatest interest, as its founder—one of the few business men interested in the movement seems to have grasped much of the idea in recent times credited to Della-Vos, and made so much of since 1876: namely, a scientific training for industrial pursuits, the teaching of theory in the class room and the application of it in shop, laboratory and field. Its early plans embraced five departments: an executive having general supervision; a scientific, with principal and necessary professors, and agricultural, mechanical and manufacturing, each in charge of superintendents. With 1,100 acres of land and a situation evidently in its favor for growth in its various lines, it is a matter of regret that business losses of the founder checked its career. The legislature was petitioned, but it gave no aid.

In even greater numbers these schools were founded farther west. There were six in Illinois, while a list of twenty is available of those in Indiana. Marking the high water mark of the movement was the organization of the Society for the Promotion of Manual Labor in

Schools and Literary Institutions in New York in 1831, "under the conviction that a reform was greatly needed, both for the preservation of health and for giving energy to the character by habits of usefulness and rigorous exercises." Mr. T. D. Weld was elected secretary with the duties of travelling, lecturing and gathering information. One report was published by him, the society holding no second meeting. Much of the value of the report is lost from its omission of all historical and statistical facts. Mr. Weld got no further than his time in the discussion of his theme. The following paragraph, widely and favorably quoted at that period, is typical of the whole report. "The states of the body are infinitely various. All these different states differently affect the mind. . . . . What duty can be plainer than to preserve the body in that condition which will most favorably affect the mind?" It was generally assumed by the friends of the movement that only manual labor is physical training. One prominent and enthusiastic worker writes, "that gymnastic exercises are both dangerous and frivolous, and that work is right because the process of training is never joyous, but rather grievous." Many attempts were made to make this system a feature of the public schools. Bills were brought before many State legislatures and congress, but in no case did one pass. Few new schools were organized after the early thirties, while large numbers of the older ones failed financially. The general interest in education was waning. Public attention was being taken to other things. Yet at this very time (about 1835) the heads of a number of the schools united in a circular which it is interesting to compare with present manifestoes of Manual Training School supporters.

(6) "The superintendents have great satisfaction in being able to state that a strong conviction pervades the minds of the young men generally, as well as their own, that laborious exercise for three hours per day does not occupy more time than is necessary for the highest corporeal and mental energy; that so far from retarding literary progress it greatly accelerates it; that instead of finding labor encroach upon the regular hours of study they find themselves able, with a vigorous mind, to devote from eight to ten hours per day to intellectual pursuits; that under the influence of this system, mental lassitude is seldom known; that good health and a good constitution are rarely, if ever, injured; that constitutions rendered delicate and prostrated by hard study have been built up and established; that this system, with temperance, is a sovereign remedy against dyspepsia and hypochondria, with all their innumerable woes; that it annihilates the dread of future toil, self-denial and dependence; secures to them the practical knowledge and benefits of agriculture and mechanical employments; gives them familiar access to and important influence over business men, of which the world is principally composed; equalizes and extends the value of education, and lays deep and broad the foundations of republicanism; promotes the advancement of consistent piety by connecting diligence in business with fervency of spirit; and especially is it valuable in training for the ministry, removing all temptation to insincerity. . . . . Students with whom this system is unpopular are lazy and worthless in everything."

There have been repetitions of the manual labor school experiment in a modified form in recent years. Amongst these may be mentioned the Hampton Institute, and the Tuskegee, Alabama, Institute. In these the opportunity is given the student to learn a trade and acquire an education at the same time. These schools do not pretend to support themselves, however, by the returns of student labor.

Beyond this it may be said that the manual labor idea survived

down to comparatively recent years in the State agricultural colleges of this country: for example, in the early seventies the State agricultural college in Kansas. That school was little else than a classical school with farm and gardens attached where the students earned a large part of their expenses.

Fellenberg's great executive ability had no counterpart in this country in the movement, which he practically headed for more than forty years.

The schools here under a different environment attempted to duplicate his work. The self-supporting feature of them here was perhaps their weakest point. The system offered a solution, which we have rejected, but for which we have offered as yet no substitute—helping deserving poor to help themslves get an education. It placed literary training and practical training side by side. It clearly recognized the necessity of physical training for the purpose of health. It saw, too, that in farming, gardening and the trades, lay many of its essentials. It recognized the corrupting influences of city life and founded its schools in the country in order to avoid them. It dignified and ennobled labor. It offered a solution for the problem of educating for the ministry. (7)

It failed, however, to correlate the school-room work and the manual work. Of manual activity as an expression of thought or as developing mental power by developing motor centers of the brain, it had no conception. Play was not thought of as having educative value. Only repeated failures forced its supporters to the conclusion that the labor of boys and girls is too unskilled and of too poor a quality to yield returns in any financial way. Neither did they see that hard, physical labor is exhausting mentally and not conducive to growth. It was reserved for later times, too, to see that for educative purposes students should be advanced to new work as soon as the task in hand is well learned; mere repetition after this point is passed has no value to the pupil.

I wish again to express my obligations to Dr. Burnham for criticism, and appreciation of the many courtesies of Librarians Green and Barton.

The history of the more recent movement of manual training has been written up in the Report of the Commission on Manual and Industrial Training in Massachusetts. Present conditions are reported by Hon. C. D. Wright in his last report as Commissioner of Labor.

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FOURTH CONGRESS OF ILLINOIS SOCIETY FOR CHILD-STUDY.

The fourth annual congress of the Illinois Society for Child-Study was held April 28,-May 1, 1897. It was preceded April 26–28, by a series of conferences of child-study workers, chiefly representatives of educational interests in the States of the Mississippi valley, for the purpose of discussing the feasibilty and plan of a North American Child-Study Conference. As a result of these preliminary discussions such a conference was tentatively formed. The plan is the result of a very general call from a large number of States for co-operative effort on the part of State child-study societies, in securing especially an adequate educational recognition of the child-study movement. That representative men and women from the several States stand ready to unite in furthering the cause of child-study was abundantly proven by the large number present at the preliminary conference and by the large number of letters presented from those who could not be present.

Most prominent among the purposes of this conference, as thus far tentatively organized, are the furtherance of State Associations for child-study, to secure the discussion of child-study problems in all fields that will be affected by child-study research, to furnish a central committee to direct the co-operative publication of such child-study literature as will best assist in the furtherance of the movement, especially along child-study lines. The organization provides for the formation of a so-called conference, to be composed of representatives from the State Child-Study Associations. The officers of the conference are to consist of a president, a vice-president, for each State represented in the conference, and a secretary-treasurer.

Dr. Wm. L. Bryan, of the University of Indiana, was elected president, and Dr. C. C. Van Liew, of the Illinois State Normal University, secretary-treasurer. The first regular meeting of the conference will be held during the sessions of the N. E. A., when it is expected that the present tentative organization will be made permanent. It remains to be seen in the future whether or not there is a distinctive work that such an organization can perform. Probably the most striking feature of the plan is that which seeks the co-operation of the various States, each through a few of its best representatives, in the much needed work of effective and systematic propaganda and educational application.

The chief interest of the week centered in the sessions of the child-study congress. Col. Francis W. Parker is the man to whom was due the credit of a very rich and attractive programme. The great success and large attendance at the congress the previous year, May, 1896, together with the unusually strong programme then presented, made it a matter of doubt as to whether as great a congress could be had in 1897. Mr. Parker, however, was fully equal to the task of eclipsing his former effort. The programme offered unusual attractions and was carried out with but two or three serious omissions, due to the unexpected inability of a few to be present. . . . It is the further purpose of this article to reproduce in brief some of the thoughts that were prominent at this congress, though it will be impossible to mention all the excellent papers and addresses.

It was not one of the least attractions during the week that delegates from a distance were enabled to visit and inspect the Chicago Normal School, and that special arrangements were made by its department of psychology, to illustrate the work of the school, especially in child-study lines. Under the direction of Dr. Colin A. Scott, physiological and psychological tests, illustrating the general work of the school, were made upon children and reports were given of the results of certain studies. In addition to this the monthly Parents' Reception, of the Chicago Normal School, which has become a recognized force in Chicago, and an open faculty meeting of the same school, also gave visitors some opportunity to see whither the educational movements of Chicago are tending.

Wednesday afternoon at the Normal School was devoted to the discussion of the formation of Mothers' Leagues and Round Tables.

Wednesday evening was devoted to the question of the relation of child-study to Sunday School work. Patterson Dubois, of Philadelphia, editor of the Sunday School Times, and Dr. Walter L. Hervey, President of The Teachers' College, N. Y., were both unable to be present, but the discussion was opened by Dr. C. A. Thurber, Dean of Morgan Park Academy, in a valuable and interesting paper on Children's Religious Notions and their Relation to Religious Training.

Dr. Thurber opened with a graphic characterization of the Great Teacher who, "set a child in the midst of a lot of grown folks and told them to become like the child," while "*we* set a grown person in the midst of a lot of children and tell them to become like him." He believed that the Sunday Schools at large have resting upon them one of the most vital of educational problems, but that, not ignoring the good already accomplished, they by no means begin to meet the demands of modern life, or modern knowledge of childhood. The Sunday School needs a great revival of interest from a new source. There is nothing about the nature of the Sunday School to prevent the use and application of every pedagogical law found serviceable in the day school, much less of the laws of child nature. "Every good result, every good method of child-study should be transferred to the Sunday School as quickly as possible that it may reap the full benefit of as good influences as there are going."

Possibly no line of individual child-study yields greater returns to religious instruction than that which seeks to know something of the child's social instincts and of his social environment. From the latter come the forces which determine very largely the source of the child's ethical and social ideals and motives. Again, the study of children's interests in literature and in nature, reveals many points of contact with the child's religious life. The study of the Contents of Children's Minds, by Dr. G. S. Hall, has shown us, also, how necessary it is for the work of instruction, wherever it is undertaken and whatever the subject, to be adapted to the individual world of thought and action in which the child has grown up. "A child's mind will profit by no other ideas than those it can assimilate. . . . Whatever theological notions are presented, therefore, must be, if they are to find a lodging place, naive and artless, simple and primitive, like the nature of the child. For anything smacking of the subtlety of doctrine he can have no real appreciation." The historical parts of the Bible should be taught for many years more as deeply interesting stories of ethical value, rather than as history and chronology. Many of the Bible maxims and sayings are unintelligible to children, because they presuppose experiences most of them have never had, *e. g.*, "a virtuous woman is far above rubies." "Suppose the 'elders of the Jews did build and prosper through the prophesying of Haggai the prophet and

Zechariah the son of Iddo;' what is that to a little child who has no conception of space, time, organized society, or even of our commonest adult conventional ways of doing things." Dr. Thurber's paper closed with an appeal to religious teachers to get back to Christ in method as well as in thought. In the discussion that followed, among those taking part in the further elaboration of the question, were Mrs. Lamareaux, of Chicago, and Col. Parker.

Thursday morning the regular opening of the congress occurred in Schiller Theatre. Col. Parker presided, and the opening address was delivered by Supt. of City Schools of Chicago, A. G. Lane. After his words of welcome, Dr. Wm. L. Bryan, of the University of Indiana, was introduced to speak on some applications of child-study. The chief thought to which Dr. Bryan gave emphasis centered about some investigations which have recently been made at the University of Indiana, under his directions. (Comp. Studies in the Physiology and Psychology of the Telegraphic Language, Psych. Rev., Vol. IV, No. I.) Briefly stated, the law is that the learner of telegraphy does not progress steadily and at a fixed ratio in his ability to receive the messages of others, but by fits and starts, increasing in speed rapidly for a time, then remaining at a standstill, then lunging ahead again, and so on, thus passing as it were a series of alternate upward inclines and level plateaus. Many get discouraged in the early plateaus and get no further,—never become expert; others achieve the highest plateaus and are known as experts. The problem that now naturally suggests itself to the psychologist is, in how far can this same law be found to be true in the acquisition of other facilities, *e. g.*, learning to speak the native or foreign tongues? The educator, too, is at once interested in the inquiry as to whether or not his own dealings with children may not be affected by the law, if it have any universal validity. He asks,—Do children experience these plateaus of comparatively stationary activity, in which no progress is discernible? Do they occur, for example, regulary, in teaching reading? In giving facility in the use of the multiplication tables? If so, how am I to conduct myself most rationally toward the child? Can he at this time of no progress be permitted to relax his efforts and let time bring about what seems to be the involuntary organization? Or must he still persist in unremitting, hard, every-day work until the plateau is passed? If the latter, how am I to carry his interest over the trial? Dr. Bryan gave no solution to these questions, but left them with the teachers for further watching and experiment. They are certainly among the most suggestive and stimulating problems that have been put before the teachers in this work.

Dr. Bryan gave way on the programme to Dr. Reuben Post Halleck, author of Psychology and Psychic Culture, and the Education of the Central Nervous System, Principal of the Male High School, in Louisville, Ky. His address was on The Education of the Motor Centers, and was ably and well delivered. He proceeded from the proposition that in proportion as the various centers of the brain are given exercise and brought out, as it were, by being called into play, does the individual become symmetrically developed. Not only all the *senses* require this development to secure the best development of the brain, but the muscles, as well, must be called into play as universally as possible, in order to secure the complete awakening and development of the motor centers. The results of the modification of the brain from motor activity are no less pronounced in the development of the brain than those from sense activity. Motor training must begin early; it is to the credit of the kindergarten that it gives emphasis to this side of the child's development. Furthermore, motor develop-

ment must go hand in hand with sense development. Motor promptings pass from sensory centers to motor cells. Out of the sensory-motor activity develops the idea-motor activity. The idea, the residuum of the old sensation that first prompted the action, now prompts the same action; thus all ideas may be regarded by the educator in the light of possible sources of action. For example, the motor element in literature should not be passed by by the teacher without being called into play in the process of interpretation; the same is true of history. In closing, Mr. Halleck called attention to certain phases of motor memory of significance to the teacher, and to the fact that only through movement is the motor side of the being primarily educated. This last thought, as he showed, carries with it far reaching and important educational considerations.

The second general session was held Friday forenoon, also in Schiller Theatre. Dr. W. O. Krohn, of the University of Illinois, opened with a vigorous and stirring address on the value of certain phases of Child-Study in the School-room. His central thought was the need of having regard for the conditions of fatigue under which many pupils are asked to work. He was especially earnest in tracing the connection between fatigue and cases of precocity and abnormality. Dr. Krohn also gave expression to some valuable thoughts on the connections between nutrition and the emotional and ideational life of school children.

He was followed by Dr. Colin A. Scott, on Morbid States in Childhood and Brain Hygiene. Dr. Scott gave a very valuable and interesting address. He impressed his hearers with some idea of the importance of studying these morbid states of children wherever they occur. In closing he gave a list of the symptoms of fatigue, which is so closely associated with many cases of mental abnormality in children, as follows: headache, morning tire and evening excitement, too great reaction, sleeplessness, losing weight or excessive fat, depression, exaltation, fears, hypogastric pains, itching of special parts, coldness or heat of special parts, numbness, lack of sensitiveness, cramp and paralysis, erethic heart, unreliable memory, impaired powers of sense discrimination (eyes, skin), yawning, and laziness.

Dr. Scott was followed by Prof. L. H. Galbreath, who read a very inspiring and valuable paper on Child-Study for Class Work. He entered a vigorous and thoughful plea for the systematization of work in child-study that shall directly subserve the ends for which the teacher daily pursues the active work of instruction. Perhaps the central problem from which such child-study for class work could depart is that of the vital connection between mind and body, a problem in which the teacher is always intimately concerned. "The teacher should be interested in the health and growth of both mind and body. He is to find and control the conditions that influence the normal development of either of these." Hence "the physical and spiritual forces which have played about the pupil from his earliest days onward, the influences that are now pouring into his young life determining the character, direction and rapidity of its flow and the energy already stored up in this stream of consciousness, are all of concern to the teacher as features and factors which he must discover in the individual, bear in mind, and utilize in his training and instruction for future power and wisdom. Such child-study for the class room must constitute an essential element in the conduct of the recitation. In no other way is adaptation of the work of instruction and of the imposition of tasks, to be secured for each individual child. In no other way can the individual conditions of apperception and of physical energy be met. Moreover the teacher must be able, not only to

read the conditions of her work in the physical expressions and manifestations of the child, but also to see in the same the reflection of her own work upon the mind through the body. Never can we get away from this intimate connection between mind activity and the accompanying nervous functions. The teacher must be able, in each individual, to read the results of her work in terms of the latter as well as of the former. These were, perhaps, the central thoughts of the paper, which were most skillfully elaborated by the speaker. The paper also contained many suggestions as to how such a line of child-study could be arranged and carried out

The two closing general sessions, Saturday forenoon and afternoon, were held respectively in Central Music Hall and the Women's Club Rooms. Very large and appreciative audiences were present. At each session the audience was favored by an address from Dr. G. Stanley Hall, who spoke on the Period of Adolescence, and on some of the Scientific Results of Child-Study, that are of pedagogical significance. It is almost needless to say, at least to those who are accustomed to Dr. Hall's charming power as a lecturer, who have already listened to his rich and suggestive lectures, that the audience drank in every word with the feeling that they were listening to a man who, by virtue of his method and its extensive application, has a right to speak with new, even revolutionary, views. One cannot but feel that it is doing the scientific laity a great deal of good to learn, as they have been doing in more recent years through the popularization of science, what it costs of effort and time and drudgery, to be able to put one's self in a position to speak with new light. This appreciation is now becoming the more apparent, that writers and lecturers, as does Dr. Hall, give their audiences some conception of the methods they employ to reach the results they present. Those who listened to Dr. Hall on this occasion had many of them heard him the year preceding, and had come again to get further help, light and inspiration. Probably nothing called out more emphatic expressions of appreciation during the entire congress, or did more to strengthen the faith in what child-study is going to do for human education and human life, than the wonderful lecture on Adolescence. The readers of the PEDAGOGICAL SEMINARY have had opportunity in its pages to gather many of these same thoughts on this and the other subject, so that we shall make no attempt here to epitomize the two addresses.

Some mention must also be made of the department meetings. Prominent among them was the Sunday School Department. In addition to the general session devoted to the pedagogy of the Sunday School already described, one session was held in the Immanuel Baptist Church. On this occásion the center of attraction was the paper presented by Prof. D. A. Kiehle, of the University of Minnesota, on Pedagogy in the Sunday School. The paper was well received and elicited an interesting discussion. The kindergartners held one session. The chief address was delivered by Miss Lucy Wheelock, of Boston, who was followed by Mrs. J. L. Hughes, of Toronto, Can., Mrs. B. Ellen Burke, of New York, and Misses Bertha Payne, Amalie Hofer and Nina C. Vanderwalker, of Chicago. The addresses were interesting and profitable, and with one exception evidence of a healthy interest on the part of kindergarteners in the child-study movement. This exception seemed to the writer to appear in a tendency to dwell upon the points in which child-study has proven the infallibility of Froebel, even to the neglect of some questions of relationship of very vital importance to the child.

The department of philosophy of the University of Chicago furnished two programmes of very great value, especially to the practical

teacher. The first of these was a symposium on expert physical examination, including The Need of Examination and Supervision by Prin. Ida Mighell, Examination from the Standpoint of Ear and Throat, Dr. T. Melville Hardie, Examination with Reference to Physical Culture, Miss Kate Anderson, of the University of Chicago, Some aspects of Child-Development, Dr. W. S. Christopher, and Supervision from the Standpoint of Contagious Diseases, Dr. W. K. Jaques. With the exception of the ladies in the list just mentioned, those taking part on this programme are all prominent physicians of Chicago, who are interesting themselves in these questions, from the point of view of their specialities. This programme was presented Friday afternoon, in Kent Hall, of the University. The same evening, and in the same place, the second programme was given by the University. Two valuable papers were presented, one on the Child and his Environment, by Dr. Mead, and the other on Method in Child-Study, by Dr. S. F. MacLennan, both of the University of Chicago, department of philosophy. Dr. Dewey presided at both of these meetings. It is to him chiefly and to his interest in the cause, that the Illinois Society for Child-Study owes the hearty co-operation of the University of Chicago, whenever possible, in its congresses.

The Art Department held one session Friday afternoon. It was in the charge of Miss Josephine Locke, Supervisor of Drawing in the city of Chicago, whose interest in the child-study movement, especially in its bearings on the art development of the child, are well known, both through her recent articles in Arts for America, and in her still more recently published guides for the Chicago teachers, which represent the practical work of the schools of the city in the line of art. The chief papers on the programme were, Art and the Child, by Dr. G. H. Mead, of the University of Chicago; Children's Fears as Material for Expression and a Basis for Education in Art, by Dr. Colin A. Scott, of the Chicago Normal School; and Primary Art Education, by Geo. L. Schreiber, of the University Settlement. The discussion that followed these addresses was especially full of life and interest in this field which has already begun to yield so materially to the influence of child-study research.

The Mothers' Department held one session, but, unfortunately, all who were to take part on the programme, with one exception, were prevented from being present. The audience was very well repaid for its trouble, however, by the excellent paper of Mrs. Ellen Burke, of New York, and the interesting discussion that followed. Mrs. Burke's paper treated of Children's Secrets. Her thoughts were presented from the mothers' and teachers' point of view and dwelt upon the need of supplying the child with opportunity for the healthful exercise of his instinct for secrets. The paper gave a most forcible argument for the need of close sympathy for and understanding of child life, in showing that the obligation is a moral one, since our very indifference (as in the case of secrets) may expose the child to temptations of our own creation, too strong and subtle for him to withstand.

For the first time in three years a new set of officers was elected, many of the former desiring to retire. Prof. L. H. Galbreath, of the Illinois State Normal University, was elected president, Dr. S. F. Mac Lennan, of the University of Chicago, was elected secretary-treasurer, and C. A. Thurber, Dean of Morgan Park Academy, chairman of the executive committee. Later in the year both president and secretary-treasurer were forced to resign owing to withdrawal from the State.

On the whole the congress was a very enthusiastic and profitable affair. The membership of the society was very greatly increased and yet the sessions had been attended by a very great many of the older

members. In no respect could the work be said to be lagging in the State that had made the pioneer effort at State organization in the movement. The writer of this report, for three years secretary-treasurer of the society, has, since the last congress, which marked the beginning of the society's fourth year, withdrawn from connection with the society to labor in another State, and hence hopes to be pardoned some reminiscent reflections on its past history and work. The spirit which brought about the formation of this society was one of reform in the school rather than of contribution to scientific data. To be sure its constitution provided for the latter also; but after all it should be acknowledged that the desire to change that which violates the child's life in the school of the present was the predominant motive. This end the work of the society has kept pretty steadily in view. It had, indeed, few among its active members who can lay any claim to having made contributions to the fund of child-study materials. But it has many who believed in the righeousness of the movement, and who desired to give it practical assistance. It is largely through the early efforts of this society that the message of child-study came to be spread abroad over the entire State. Teachers were stimulated to study their own children in the school-room, mothers their children, and both ultimately to turn to the great field of child-study literature that could show them what has already been done to render child-life and growth more intelligible. To this end the publications of the society were issued. They reveal little of the work actually done by its members in the study of children, and that little is rather crude and of meagre value except as a stimulus to others. Their chief purpose was rather to furnish suggestions for observation, and articles for study. In these respects the publications contain very much that is of great value. Under the auspices of the society a large number of Round Tables have been formed, which have carried on the study of child-study literature, and in some cases have even grappled with small problems. Many mothers of the State, and a number of the women's clubs, have become interested in the work. There are also many schools in the State, where important changes have been wrought in the curriculum and method, and especially in the physical environment of the child, due to the work of propaganda carried on by the society. Finally the society has helped to influence materially the work of professionally training teachers. But on the other hand, at no time has the society as a body despite the dreams of some, ever been brought to the pursuit of a single problem that might yield something of scientific value. It may safely be doubted if, indeed, this should ever be its province. It is a good thing to have served in bringing about about a more open and receptive attitude of mind on the part of many on all educational problems. It is a good thing to have helped many to see that these things still are problems. There is still very much work of this kind to be done, and in connection with efforts at securing the recognition of new needs, indicated by new truths, there is still a good field before the society

C. C. Van Liew.

BLOOMINGTON CHILD STUDY CONFERENCE, MAY, 1897.

Communicated by Dr. W. L. Bryan.

The week following the Chicago Convention, above reported, a three days' child study conference was held at Indiana University, at Bloomington, where, besides three addresses given by Dr. G. S. Hall, but not here reported, the following addresses, kindly condensed by the authors, were given.

Child Study and the Teacher.

Supt. W. H. Sanders, Rensselaer, Ind.

The teachers of Indiana have done systematic work for several years along the lines of Psychology, Pedagogy, and History and Philosophy of Education. A very large per cent. of the teachers in the State have done some work of this kind in our normal schools, colleges, or universities. Almost all our teachers take the Indiana Teachers' Reading Circle Work, which has from its beginning, in 1884–'85, directed the teachers in these fields of investigation. The instruction given in county institutes and in township institutes, as well as the various associations, has been largely of a professional character. The knowledge and discipline coming from this continuous study of professional questions will be helpful to us in entering upon the new field of study.

But while the teachers of Indiana have done a great deal of work as indicated above, I, as one of them, cannot but feel that much of this study has been too theoretical and speculative. It has dealt with "the child in general," "the average child" and "the ideal child." Though we have been taught and have taught that the child has both a physical and a spiritual nature, yet we have frequently ignored the fact of the intimate relation and dependence of these natures upon each other. We have often proceeded as if the child were a spirit unincumbered by its physical being. Our proneness to theorize has too frequently taken us out of the true field of Psychological and Pedagogical research, *i. e.*, the individual children that come into our school rooms from day to day. The Indiana Child Study Society will, I believe, be a force that will bring us back to the pupils and direct us in a more careful, as well as a more sympathetic observation of their habits, tendencies and dispositions. If it succeeds in doing this it cannot help being of untold value to the schools of our State. Our previous theoretic study of Psychology will help us in making more acute observations than we could make without this study, and it will aid in the interpretation of the phenomena observed.

One line of work which, in my judgment, needs our study, is that of "Over Pressure." I believe it is not too much to say that there is scarcely a conscientious teacher or pupil in our schools who is not overworked in the discharge of the duties incumbent upon him in the course of his daily work. We who have as a part of our duty the preparation and enforcement of courses of study, have not sufficiently regarded the physical welfare of teachers and pupils. The quantity of work is, in many cases, too great, and in other instances the work is too difficult for the advancement of the pupils. This leads to worry

and a useless expenditure of energy. Teachers and pupils alike are up late at night preparing lessons, as they think for the following day, but in reality they are depriving themselves of needed rest and refreshment which impairs their strength for the duties of the morrow. Again the work required is not adapted to the changing physical and mental condition of the children as a result of growth. To any observant teacher or superintendent it must occur that the great amount of nervousness, headache, nose-bleed, etc., which he sees from day to day is not without cause, and furthermore that the cause lies very near the schools. Both teachers and pupils have certain social duties to perform as well as school work to do, and we often take no account of this in the assignment of work to be done. Social duties cannot be wholly neglected. Some time and energy will be devoted to these, and hence less energy is left at the disposal of the school. This pressure from school and social duties combined is making rapid progress toward undermining the physical well being of our best teachers and pupils.

Child Study in the Public Schools.

Supt. Wm. A. Millis, Attica, Ind.

1. "The abiding results of child study must be sought in the psychological laboratory. Scientific child study by the teachers in the public schools is impracticable. Nor do I think that the science of the child will be developed in the normal schools for the reason that they are technical rather than scientific institutions." "This purely scientific study of child nature is practicable only in the university laboratory, by individuals with special aptitude for such work, or in field study under the immediate direction of the specialist."

2. "To our normal schools belong the questions of the wisest adjustment of studies and methods of instruction to child nature. The normal school is in a very real sense an educational experiment station—a center for investigation of the problems of child culture, of proposed instruction, of the problems arising in the art of teaching. This the public school cannot and ought not to be."

3. "Scientific child study belongs to the university and the specialist; the adjustment of educational means to the nature of the child as determined by the scientist belongs to the normal school; the modification of this adjustment to fit the nature of the individual child belongs to the teacher in ranks. The last is the child study that belongs to the public schools,—namely: a study of the particular conditions entering into the lives of the pupils and which must be estimated in the adjustment of the accepted appliances and methods to their development."

4. As a means of inspiration and nurture, teachers should be kept in close touch with the investigations in progress at the several centers of child study. The questions raised should be known. The teacher who possesses a clearly defined notion of one or more of the larger problems in issue, will unconsciously awaken to new truths and to new life. It is an excellent thing for the teacher to select some one of the "wise questions" of the investigator for her own and keep it as a kind of interrogation point over her work. "Original investigation" must be left to the laboratory.

5. "But chiefest of all, the teacher must *know* her pupils. She must know their capital stock, their resources and liabilities. She must know their physical condition, their nutrition, their nerve capacity, their defects. The home life of the child—the home atmosphere, family temperament, social standing, parental attitude toward school and culture institutions in general, and the degree of individuality per-

mitted the child in his home life. Has he private property in anything, even in his own feelings? These are the questions which the teacher can and ought to investigate. She ought to know what her pupil reads, what he has seen and heard, what games he plays and how he plays them, whom he worships as his hero, and particularly the boys and girls he admires. She ought to know how he has been disciplined and for what reasons. She ought to know how he spends his leisure hours and vacations, what he likes and dislikes, and why, his interests and his apathies. In short, the teacher should know her pupil as she knows her own soul at confession. Such intimate knowledge of real live boys and girls will beget that loving comradeship that is better than all science and method and apparatus. This is the school room child study that is of most value."

Child Study for the Grade Teacher.

Supt. B. F. Moore, Frankfort, Ind.

One difficulty in the way of getting the grade teacher to take up child study is lack of interest. Teachers are not interested because they do not realize that such a study has any direct bearing upon their immediate work.

To meet this difficulty the beginnings of child study for the common school teacher should be such as will appeal to her in the direct line of her work. Teachers are mainly concerned in processes of teaching; in applying courses of study to the individual children in their schools, rather than determining what courses of study shall be. The child study of greatest interest to the teacher will not be some of its more scientific phases, but will be such a study as will enable her to grasp more clearly the problem before her; as will open up to her more rational methods of procedure; as will enable her to more intelligently apply the matter in hand to the individual pupils before her. Child study must be brought to the plane of the common school teacher if she is to become interested in it.

Many of our teachers have been carrying forward lines of child study from the above standpoint. In all cases, where systematic observations and tests have been made, it has been to determine some particular element in the child's make up, and always with a view to changing processes of dealing with the pupils as the result of the observations or tests showed it to be necessary.

Child Study and the Common School Teacher.

Professor Howard Sandison, Terre Haute, Ind.

I. The world has been given to periodic movements. Examples are Buddhistic movement, the Mohammedam reform, the Crusades, the revival of letters, the phonic movement, the object lesson movement, etc. Along with these belongs the child study movement. Each of these movements expresses the dissatisfaction of the race with the existing state of affairs.

II. How the child study movement differs from the other. Each of the other movements had as its center of interest a limited object. The Crusades related only to the religious life, and this in one of the smaller aspects. The object lesson movement related only to education, and to a limited field in that. The child study movement has as its center of interest something far more fundamental and comprehensive—the child with the full range of its possibilities.

III. The movement is not new. Throughout the history of the race the child has been an object of interest and study. All the great reformers have given emphasis to the child and his interest, many of

them have pointed out the necessity and the advantage coming from a study of his nature. A few have gone far enough as to indicate briefly plans. As early as the time of Plato definite hints concerning the study of children were given. Quintillian and Rosseau have attained more definite results. Froebel based his system directly upon the study of children. Notwithstanding this the movement has assumed general importance only within the last few years.

IV. Lines of Child Study work.

a. The strictly scientific study of children. The child is as truly a subject for scientific investigation as is the plant or animal. This scientific study may not, however, have immediate reference to pedagogy.

b. Scientific study and experiment in the laboratory having direct reference to pedagogy. Experiments may be made in the laboratory, and investigation in children over wide ranges of territory, in order to obtain conclusions which may be embodied in pamphlets, books, magazine articles, etc. These being placed in the hands of the common school teacher, become valuable guides on account of their educational doctrine.

c. Direct work by the common school teacher. The common school teacher in charge of a room, owing to her intimate acquaintance with the children and the mutual sympathy existing, has opportunities for study greater even, than the scientific investigator in the laboratory. The direct study made in the school room shows itself to be of three kinds; one of these is the following: the teacher by conversation with a child, no others being present except the stenographer, may, in a sympathetic way, obtain from the child his ideas, feelings and choices concerning any region of knowledge, as, for example, his ideas and feelings concerning the world to come, or his ideas concerning books, plays, etc. A second kind of work is the observation to be made by the teacher upon all the children in the room as they move forward in their daily work. This can be truly scientific in its nature, involving close observation, hypothesis, deduction, and application. It may also be studied in relation to schoolyard plays, home environment, etc.

A third kind of work, which the common school teacher can carry on, is one extending beyond any single room. This is a kind of work intended to test the attitude of children in the different grades toward any subject. For example, a certain experiment in physics may be taken. This being shown in each grade, the children may be led to ask questions or to make statements concerning it. If a large number of such questions or statements are collected and classified according to the grades, the prevailing interest of each grade concerning that kind of work may be discovered. This will be of value in deciding how to organize that line of work in the school.

Practical Value of Child Study.

Myrtle L. Smyser, Indianapolis, Ind.

Child study is of practical value to the teacher.

First. In that it arouses in the teacher a love for children and love for her work, without which there can be no really successful teaching.

Second. Discipline becomes more natural and easy to one understanding the general principles of fatigue, periods of maximum growth, adolescence, etc. Fatigue is important in the arrangement of programmes. Fatigued children are slow of comprehension, restless and irritable. Change of work at the proper time is necessary to get the best results with the least strain to teacher and pupils. An understanding of the periods of growth is important in the arrangement of school

courses and in the work of teachers with individual children. Variation of mental and physical power at different ages, seasons of the year and hours of the day, is a valuable study for any one who deals with child life.

Third. Instruction from one in sympathy with the child's mental, moral, and physical nature, makes possible a deeper, nobler development of the highest powers of the child. The Emotions and the Will—the art of living and loving are too often neglected.

Not the least of the practical results of child study is the effect it will have upon the profession of the grade teacher. Teachers are but children of a larger growth. It will be found that the best work is not separable from health and happiness. Love of work is necessary, and child study adds so much of vital interest that it cannot help but attract the class of teachers so desirable, yet so difficult to obtain.

Dr. C. C. Van Liew, Normal, Ill.

In his opening remarks Dr. Van Liew urged the need on the part of teachers of acquainting themselves with the literature of child study. The principles of their practice are necessarily of the most general nature, and in order to appreciate their true significance the teacher must be able to recognize them as they appear modified by the phases of life and growth that are peculiar to the child. We need sympathy with child life and child nature to be able wisely to apply the profoundest law that the scientist or philospher ever formulated. Sympathy with the individuality of the being that he is trying to influence is evidence of the presence of the artistic element in the teacher.

Another field of interest for the teacher in this movement of child study is the study of the individual. This is, in fact, pre-eminently the field for the teacher's interest in her own study of children. The close and sympathetic study of individual personalities cannot fail to reveal not alone useful information for the training of that child, but intrinsically interesting and valuable knowledge of child life. It may not be new to the science ; but its closeness to life itself is the great fact in its favor. It is the student's method of the laboratory transferred to the school room, which thus becomes to the teacher, not alone a shop for turning out work, but as well a laboratory for the constant investigation of the forms of life she is most intimately interested in. And the teacher needs this cultivation of the power of recognizing the distinctive features of the beings with whom she deals, and the individual conditions under which she works, as well as the worker in any field. Often in conjunction with this study of the individual, the teacher finds it to her advantage to be conscious of the problems which are at times uppermost in the minds of the scientific investigator. For example, we have been shown that Dr. Bryan's problem of the plateau, undoubtedly has a bearing on certain work of the school room, and that it is very suggestive to the teacher in certain phases of her work, offering a point of view in the observation of the results of her own work, and giving her an opportunity to contribute to the practical testing of certain child study problems in a way that no one else can contribute.

But probably it is by no means too early in the history of the movement to expect of the work of child study some contributions that are able to affect the work of education. In fact, there is a great deal that has already been revealed that should be a part of the professional knowledge and equipment of every teacher. The entire body ot knowledge relating to the physical growth and development of the child, gives, perhaps, as good an example as any of how imperative it is that the teacher be informed as to the recent revelations of child study.

Recent studies in imitation offer another illustration of the essential contributions that are being made to the practical field of the teacher. The results of these studies have been pushed far enough to make suggestibility and imitation not merely side issues in the development of the child, but positive factors, worthy of recognition as educational principles. The best that we possess in all our arts of expression, from physical mannerisms to speech, composition and art, are, in so far as they become efficient and of ready command, due to the principle of unconscious imitation. It follows that in teaching the child to read, write, speak correctly, or to perform any one of the common school facilities that add to the child's power of expression we should make a far greater use of this principle of unconscious imitation. As well teach the child to have an agreeable expression of the face by making faces for his conscious imitation, as to have him learn to read or write by rule instead of by the use of his motor instinct. The expressive environment begets the expressive motor response in the child. Take care of the copies and the child will grow up to their standards. Finally, this principle has a further field of application for the teacher in that it shows the effect of the personal suggestions of the environment upon the child's emotional attitude toward his work. The school environment, or the home environment, becomes positive or negative in its emotional effects according as the suggestions which the child draws from it are such as recognize what power he has, as encourage effort, as inspire confidence in that already accomplished and possessed as something positive, or as they rather call to mind his deficiencies, how far he is behind others in his accomplishments, leaving him with no sense of power possessed, or of worthy work accomplished. It is well worth considering to how great an extent the unfavorable emotional tones of the pupil are due to thoughtless, unwise or vicious suggestions of the school environment.

CORRESPONDENCE.

To the Editor of THE PEDAGOGICAL SEMINARY:

Dear Sir,—

Mr. Partridge, in a foot note to his interesting study on "Blushing" (PED. SEM., Vol. IV, No. 3,) says: "The literature of the subject. . . . . is meagre." Certainly it is, but it does not appear that he has exhausted the material at hand. I wish to call attention to a helpful monograph[1] published somewhere in the eighties (the date is not given, but a copy is in my possession at least 14 or 15 years) whose author discusses the subject in a rather thorough manner and arrives at conclusions similar to those of Mr. Partridge. I translate a few extracts for the benefit of those interested in the subject.

Henle takes exception to Darwin's explanation of the phenomenon of blushing, and also rejects the theory that it is due to an acceleration or stimulation of the action of the heart. He shows that a closer microscopic examination of the tissues composing the walls of the blood vessels reveals the fact that there are involuntary muscles of an annular form imbedded in the elastic fibrous tissue. "The last doubts as to the contractility of the blood vessels have been removed by Bernard . . . . who proved that these vessels are controlled by the nerves in the same manner as the voluntary muscles." Consequently, mental states may cause contractions or relaxations of the capillaries, which in their turn will produce a temporary decrease (pallor) or increase (blush) of the volume of blood in these vessels.

That the blush is, in the main, restricted to the face and neck, cannot be explained, as Darwin does, as an effect of the "concentration of attention to the exposed part." "If concentration of attention upon the face were cause enough to increase the quantity of blood in the capillaries of the face, we ought to blush whenever we look attentively at our face in the mirror." And "if we fix our gaze upon the pretty hand of a lady who is conscious of this distinction, we may never observe a blush on her hand, but only, perhaps, in her face."

While this argumentation may be regarded as somewhat superficial, Henle's further statements are interesting. "When it is asked," he says, "why the blush appears mainly and primarily in the face, we must consider that this peculiar localization of effect is characteristic of *every* case of dilatation of the blood vessels under the influence of an emotional state. I believe to have found an explanation of this fact. The nerves of the blood vessels do not stand alone in this respect; as I have had occasion to show in one of my lectures on anthropology, the nerves of all voluntary and involuntary muscles, the sensory nerves of the skin and even those of the glands, whenever they are at all affected by mental states, participate in the emotional excitement in the same order, viz.: first those of the head (facial muscles, lachrymal gland), and then, in proportion to the intensity of the feeling, from the head downward. The common cause of this sequence must be found in the anatomical arrangement of the nerves of the body: those that innervate the upper part of the body being in greater proximity to the seat of psychic activity than those controlling the lower

[1] "Ueber das Erroethen," von J. Henle, Breslau, S. Schottlaender.

parts. . . . . The characteristic feature of the blush of shame, therefore, is not the fact that it covers the face, ... but that the face blush is the principal, often the only outward sign of the emotions which it signifies. This peculiarity ean only be explained by the particular character of the feeling of shame, in distinction from other blush-producing emotions. . . . ." (Cf. Mr. Partridge's article, p. 390.)

"The mental state which produces the blush proper, belongs to the class of depressing emotions. The dread to be observed in public, which colors the cheeks of timid maidens (and youths) even on entering a place of social intercourse, or at a greeting in the street; the feeling of alarm at being tempted into revealing a secret, or at the possibility of being caught in an untruth; yes, even the apprehension of arousing the mere suspicion that there is anything to be concealed or that one has been guilty of prevarication: all these are emotions which differ from *fear* of a threatening danger only in degree and mostly also in duration. And it often happens that a blush is immediately followed by the pallor of fear, or that the latter occurs alone when the former might be expected. Even the feeling of shame proper, especially when it is awakened by a surprising, alarming situation, may find expression by a pallor spreading over the face rather than by blushing. How, then, can it happen that moderate fear and terror will make us blush, as a rule, while stronger fear and more intense terror will cause us to turn pale? The explanation of this contradictory behavior is found by remembering that pallor is produced in one of two ways, either by contraction of the blood vessels, or by momentary cessation of the heart beat. Contraction of the blood vessels occurs, as was shown above, in consequence of depressing emotions; but fear and terror, in order to produce this effect, must reach *a certain degree of intensity* and are then accompanied also by other symptoms, such as contraction of other involuntary muscles (of the skin and lungs), and decrease in the power of control over the voluntary muscles (trembling). A temporary *dilatation* of the vessels, however, seem to be the first result of every *less* serious disturbance of the equilibrium of the mind, even of a passing alarm, of a merely incipient fright. If, under such conditions, a pallor is observed instead of a blush, this may be explained by an abnormal condition of the heart, which with many individuals changes its beat from very insignificant causes, and, by a sudden convulsion, or a temporary paralysis, may be prevented from dispatching the normal quantity of blood to the arteries. That the blush is an effect of relatively weak emotions, is also proved by the fact that this one change of physiognomic expression remains the only one . . . . the muscular movements which accompany the blush, the drooping of the eyelids, the shifting glance, not being direct reflexes of the emotion, but (like the attempt to conceal one's self or at least one's face) voluntary and purposive actions. . . . . It will be plain, then, why I distinguish the feeling of shame only quantitatively from other depressing emotions, so that no sharp line can be drawn between them."

In this connection, it will be instructive to consult Wundt's remarks on the physiology of blushing;[1] his line of argument being very similar to that of Henle, though the latter seems to claim priority for his theory.

Respectfully,

MAXIMILIAN P. E. GROSZMANN,
Comenius Grove, Va.

[1] "Grundzuege der physiologischen Psychologie," von Wilhelm Wundt. First edition, 1874, Leipzig, Wilhelm Engelmann.

LITERATURE.

Thomas and Matthew Arnold and Their Influence on English Education, by SIR JOSHUA FITCH. N. Y., Scribner, 1897. pp. 277.

This very brief account of father and son is attractively put together, but the picture of the elder Arnold gives nothing of consequence not told, as we remember, in Stanley's life; while the story of Matthew Arnold is compiled from many literary notices and colored by a long, personal acquaintance. The services of the latter for education are, of course, chiefly dwelt on; but perhaps the best chapter in the book is devoted to his literary work.

The Golden Age, by KENNETH GRAHAME. N. Y. and London, 1897. pp. 241.

The olympians or parents and "grown ups" generally were regarded by the children as their betters by a trick of chance only, but unable to make use of their luck because their lives were so slow, senseless and void of interest. What did they know of Indians or pirates, of fairies or buffalo, although in the child's mind the woods were full of them. These anæmic adults dragged out an aimless existence, talking of inanities they called politics, society and what not, and were really further from children than the kindly beasts. They were a blind fate, ruling by strange and alien laws, who could not understand what real life was. From this general standpoint the incidents of the daily life and conversation of a group of bright children are described. The book is charming and animated by a real and deep sympathy with children, but fails a little in the second half, as if the author or his unique vein had begun to run dry.

A Working System of Child Study for Schools, by MAX P. E. GROSZMANN, PH. D., Syracuse, 1897. pp. 70.

Child study is for this author merely a new name for an old thing. He has little interest in researches based on numerous data, but tells us of special methods of gradation, reporting on thirty points, including sense defects, whether each child is musical, artistic, lazy, nervous, observant, etc. Children are often thought dull by one teacher and shy by another, brilliant by parents and dull by teachers. Dr. Groszmann's booklet, while not helpful to the expert in child study, will be found suggestive to teachers in small private schools, where individual traits of body and soul can be studied and brought out by a scheme of reports that are illustrated in full.

The Child Life. Primary Reading and Education Chart, edited by MARY E. BURT. Ginn & Co., 1896.

This is twenty-seven large and reversible charts containing a complete course of primary study, with many original drawings and copies, sometimes colored, from the great masters. It makes possible an interesting experiment in class, as opposed to individual work. The results ought to be of value. The ensemble makes a favorable impression.

La Puberté chez la Femme, par C. H. BARBAUD et C. H. LEFEVRE. Paris, 1897. pp. 234.

Puberty is here treated physiologically, clinically and therapeuti-

cally. The effects of climate and other causes that accelerate or retard its advent in girls, is first discussed, then follow a characterization of the difference between puberty and nubility, the effects of precocious marriages, the physical and mental peculiarities of this period, its irregularities and diseases and their treatment. Nothing new is attempted, but the book is the best general summary of the traits of this important period of life known to us. The abnormal or morbid side is a little too prominent for general reading, perhaps even for greatest pedagogical utility.

Thirty Years of Teaching, by L. C. MIALL, F. R. S. London, 1897. pp. 247.

The author has a brief chapter on each or nearly all of the topics of instruction with suggestive discussion or punishments, plain speech, reading aloud, Froebel and Pestalozzi. All in all it is a charming and suggestive book, but not by any means a remarkable one. Some of the topics are particularly disappointing and show little knowledge of the best work done elsewhere. This is particularly the case in the discussion of school museums, nature study and the relation between pedagogy and psychology. "In lecturing, make no introductory remarks, and rarely any closing ones; go to nature rather than books; be accurate." Many such well known principles are freshened up by new illustrations in this rather journal-like and scrappy, but very interesting book.

School Interests and Duties, by ROBERT M. KING, Instructor in the Indianapolis High School.

Whether this is a very old or a very new book, it is impossible to tell, as, like so many of its class, it bears no date. The topics are old and the treament is conservative, and on the title page we are told that it is developed from Page's "Mutual Duties," and from various reports, documents and bulletins. The chief topics are duties of parents, teachers, officers, school architecture, hygiene, libraries, morals, etiquette, celebrations, dictionaries, institutes, reading circles and public opinion. The author aims at nothing startling or novel, was no doubt himself much developed by compiling it, and every teacher will find it handy and practically suggestive.

Organic Education, by HARRIET M. SCOTT, assisted by Gertrude Buck, Ann Harbor, 1897. pp. 291.

This manual for teachers in primary and grammar grades is by the principal of the Detroit Normal Training School and a high school instructor in English. Its purpose is to report a plan of work that has been some years in operation. The brief first part gives the philosophical principles, and the last is a detailed statement of how the plan is carried out. It illustrates the nomadic or American Indian period by Hiawatha, the pastoral or early Aryan period by Karlu, the Persian or agricultural by Darius, the Greek by Cleon, the Roman by Horatius, the Saxon by Wulfe, the French by Gilbert, the Spanish by Columbus, the English by Raleigh, the American by the Puritan. For each of these there is first an analysis of character, then "ethical aims," then, where feasible, "ethical ideals" embodied in literature, or a general statement of material, For each there is also a discussion of appearance, clothing, home, school, social and industrial life, the State and religion. It is a culture epoch plan with excellent new variations and requiring a great deal of work on the part of the teacher, but the references are all given by the score. We doubt if many teachers would or could carry out this attractive plan, on account of the laborious reading it would require to do it well.

Bibliography of Education, by WILL S. MONROE, A. B., N. Y. Appleton, 1897. pp. 202.

This is No. 41 in the International Educational Series, is dedicated to Dr. Henry Barnard, and contains titles of 3,200 books and pamphlets arranged under twenty-two general heads, most of which have many sub heads. On the whole it is, as the latest should be, the most valuable of several now before the public, not excepting that of the writer. The author has had the preparation of his collections under way for sixteen years, has made an excellent index and occasionally gives a few lines of characterization of more important work, usually in the form of quotations. It was no doubt wise to exclude periodical literature, but the necessity is to be regretted, most perhaps in the field of child study and university work, where the most important of all literature is perhaps periodical and the absence of which makes those rich fields seem rather jejune.

Matka and Kotik: A Tale of the Mist Islands, by David Starr Jordan, President of Leland Stanford University. San Francisco, 1897. pp. 68.

This elegant little book, with nearly four score pen sketches and seal photographs, and more than a score of "personae," is a story of seal life, dedicated to the other members of the Behring Sea Commissioners for 1896. Matka is the wife and Kotik the child of the great beach master, Atagh, and besides many relatives are Amogada the walrus, Sivutch the gray sea lion, Eichkoa the blue fox, the auk, sea parrot, gull, with a chorus of various animals, volcanoes, wind and sea. The story is a sprightly account of the interesting habits of the seals at the breeding season, and of animal life in the Alaskan region. The idea is happy and unique, and the book will delight every child, to say nothing of "grown ups."

The Great Didactic of John Amos Comenius. Now for the first time Englished, with Introductions, Biographical and Historical, by M. W. KEATINGE, B. A. London, 1896. pp. 468.

The greatest work of the great School Reformer is here presented to English readers for the first time. "The present version of the *Didactic Magna* is a close paraphrase of the original Latin in the Advocates' Library, Edinburgh. The introductions are based upon original research and on the best German authorities. They embody a fuller account of Comenius's life and works than has hitherto been accessible to the English reader." The introductions comprise some 150 pages and are scholarly contributions to educational history. The translation is clear and forcible, and bears the stamp of accuracy in reproducing the thought without undue slavery to the literal form. Notes and a bibliography are appended.

It was not without reason that Comenius maintained that this book set forth "the whole art of teaching all things to all men." For the chief contributions of pedagogy since its appearance in complete form in 1657 have been to illustrate these principles, to repeat them in new form, or from inductive study to show their application. The importance of the original and the excellence of this translation are both suggested by the words of Comenius on the title page. "Let the main object of this, our Didactic, be as follows: To seek and to find a method of instruction, by which teachers may teach less, but learners may learn more; by which schools may be the scene of less noise, aversion, and useless labor, but of more leisure, enjoyment, and solid progress; and through which the Christian community may have less darkness, perplexity and dissension, but on the other hand more light, orderliness, peace, and rest." W. H. B.